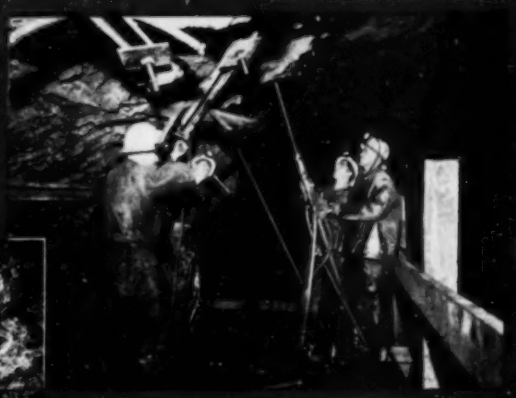
CIVIL ENGINEERING

JUNE 1953

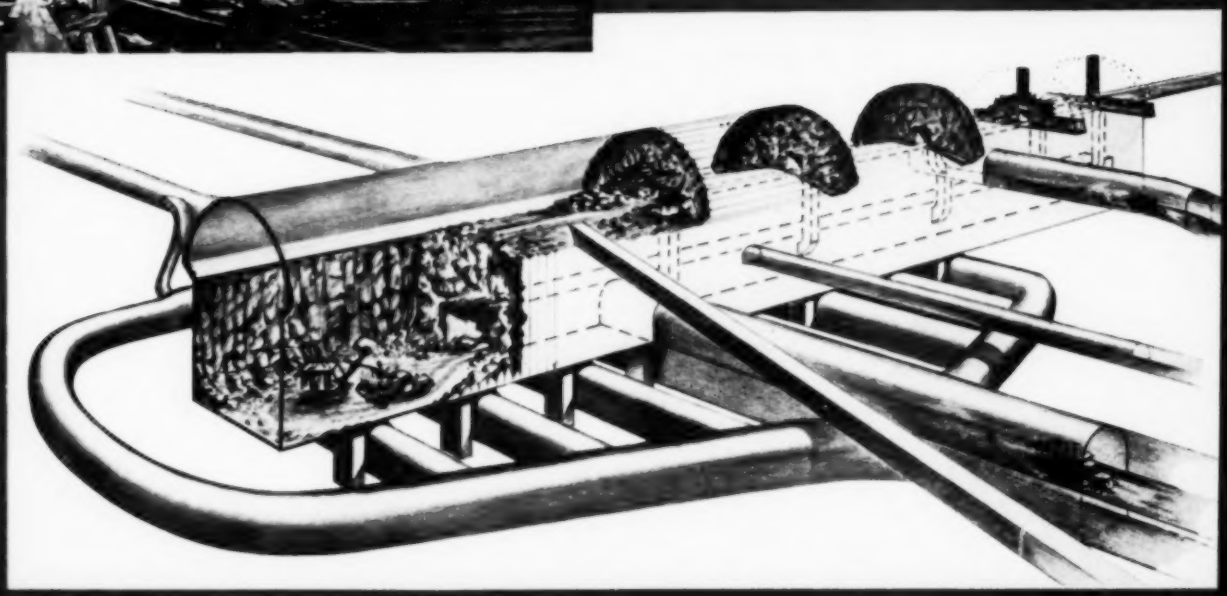
THE MAGAZINE OF ENGINEERED CONSTRUCTION

ALCAN-BRITISH COLUMBIA UNDERGROUND POWERHOUSE

See article by W. G. Huber



Main powerhouse chamber, high as 10-story building, was attacked through pattern of tunnels and drifts (below). Loose rock was drilled and pinned (above), and roof concrete pumped in behind traveling form (left).



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THE SCOPE OF RAYMOND'S ACTIVITIES—Soil Investigations . . . Foundation Construction . . . Harbor and Waterfront Improvements . . . Prestressed Concrete Construction . . . Cement-mortar In-place Lining of Water, Oil and Gas Pipelines.

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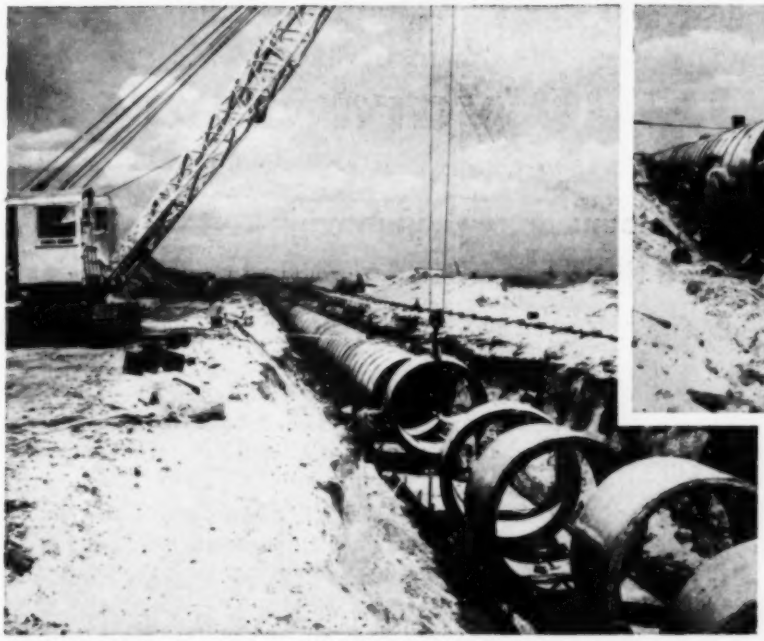
AT NEW YORK INTERNATIONAL AIRPORT . . .

American Welded Wire Fabric makes drainage pipe last longer



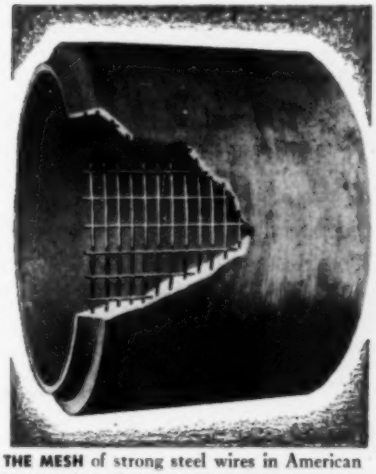
DRAINAGE PIPE being installed at New York International Airport. Concrete pipe reinforced with American Welded Wire Fabric was used for most of the drains at this huge airport. This pipe resists cracking and can withstand heavier loads than ordinary concrete pipe.

REINFORCED CONCRETE PIPE is used extensively for separate, combined, and storm sewerage systems. It is also used for drains adjacent to highways or railroad tracks, and for airport drainage systems.

NEW YORK International Airport is big. And most of the *4900 acres* of it are drained through reinforced concrete pipe that is strengthened with American Welded Wire Fabric.

Reinforcement with American Welded Wire Fabric assures strong, durable concrete drainage pipe. High tensile steel wires, securely welded at every intersection, add strength to the pipe, prevent serious cracking, and increase the service life of the pipe. This fabric is used to increase the life of highway, railroad, and airport drains, storm sewers, and sewage force mains.

For extra strength and durability in *your* concrete pipe, make sure it is reinforced with American Welded Wire Fabric. It meets applicable A.S.T.M. Specifications.



THE MESH of strong steel wires in American Welded Wire Fabric distributes load stresses more evenly throughout the pipe. It provides a better bond with the concrete than ordinary wire reinforcement.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION, GENERAL OFFICES: CLEVELAND, OHIO

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

EVERY TYPE OF REINFORCED CONCRETE CONSTRUCTION NEEDS

U·S·S AMERICAN WELDED WIRE FABRIC

UNITED STATES STEEL

CIVIL ENGINEERING, The Magazine of Engineered Construction, June, 1933. Vol. 23, No. 6. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

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How to start a 6,000,000 yard dam

Building Lucky Peak Dam means more than moving earth. Before a scraper appeared there were back-breaking preliminaries.

Huge Lucky Peak Dam, a colossus of earth, rock and gravel, is racing towards completion 10 miles east of Boise, Idaho.

But the 6,000,000 yards of dirt and rock that will sit astride the unpredictable Boise River will rest on a solid foundation of preliminary work started back in November, 1949—almost 4 years ago.

When swift, powerful earthmovers—there are 19 Caterpillar* DW20s and W20 Wagons, seven Cat* D8s and a No. 12 Motor Grader at work now—begin disgorging their tons of dirt, results are immediately evident. Not so dramatic is the preliminary work, but no dam builder underestimates its importance.

Before a yard of earth could be moved to the dam site, miles of roads had to be relocated, a steel ribbed diversion tunnel had to be burrowed, drilling had to be finished, temporary roads had to be built and maintained, gravel plants had to be set up, land needed had to be cleared and leveled on schedule.

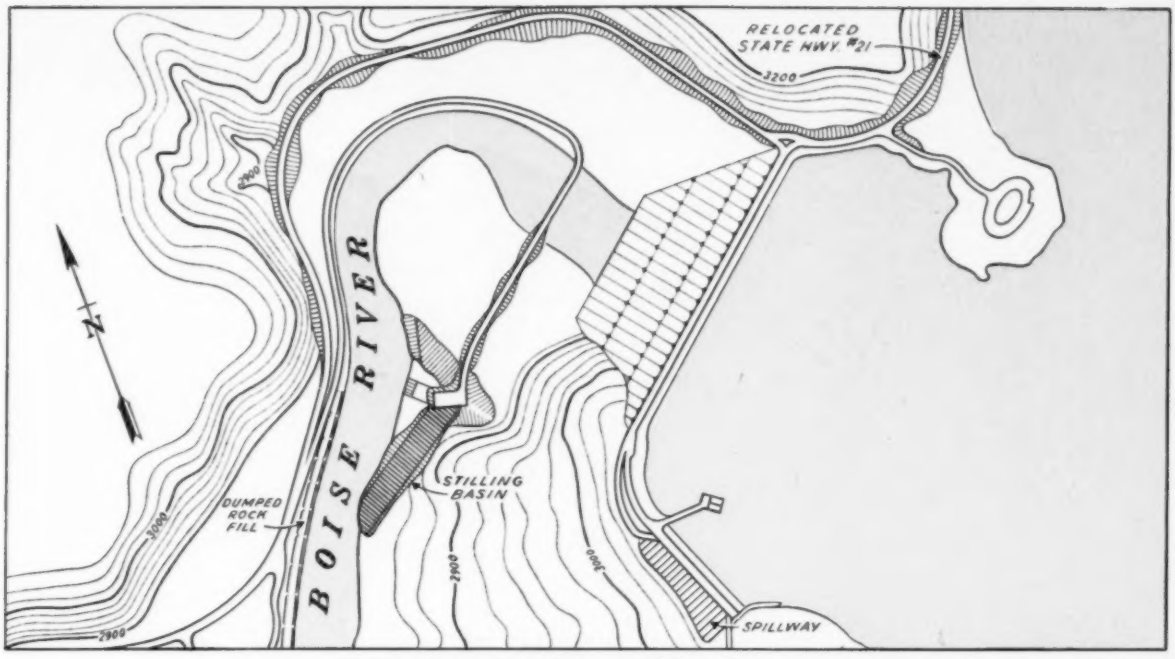
This, then, was the job of Morrison-Knudsen, Terteling, Macco, and Puget Sound Construction Co. And the companies put their trust for this diversified work in a variety of dependable Caterpillar products.

Caterpillar D13000 Diesel Engines provided the steady power for Gardner-Denver compressors for drilling. An ingenious homemade loader was mounted on a durable Cat D8 Tractor for heavy loading. Another D8—this one mounting a No. 8A Bulldozer—teamed with a versatile Caterpillar No. 12 Motor Grader on relocation of 31.3 miles of county, farm and state roads.

An Eimco loader was mounted on a rugged Caterpillar D4 Tractor for work in the diversion tunnel which moled 1,161 feet through an almost solid rock canyon wall. The tunnel was holed through in 106 days.

These were the first steps in building the $18,500,000 Lucky Peak Dam on the Boise. Finished, it will tower 328 feet and be a quarter of a mile thick at its base. Behind

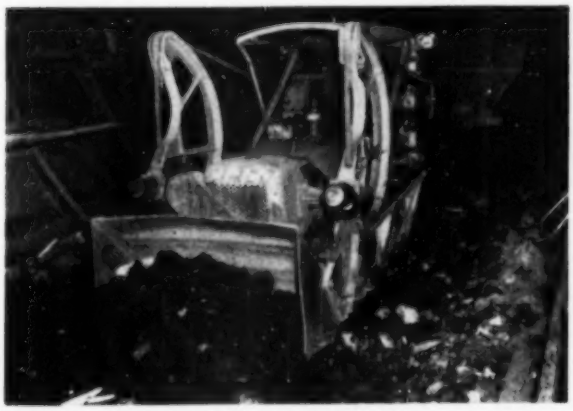
IMPORTANT PART of the preliminary work was drilling on the diversion tunnel. These three Gardner-Denver compressors are powered by three Caterpillar Diesel D13000 Engines.



GENERAL PLAN FOR LUCKY PEAK DAM, its diversion tunnel, relocated roads, spillway, stilling basin, is shown on this map. The dam, 10 miles east of Boise, Idaho, will cost approximately $18,500,000.

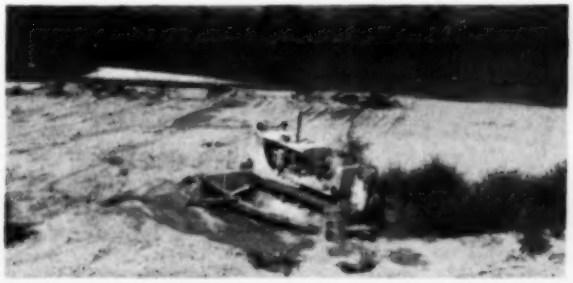
its 2,200 foot crest length, it will stem more than 300,000 acre feet of water draining into the reservoir from a 2,600 square mile area.

Important work calls for reliable equipment. Big contractors standardize on Caterpillar products for a number



IN THE 1,161 FOOT DIVERSION TUNNEL an Elmco loader mounted on a Cat D4 Tractor works swiftly. Tunnel was holed through in only 106 days!

of reasons. They know its simple, rugged construction means longer life and less down time. The engines are economical to operate, using No. 2 furnace oil for fuel without fouling. And maintenance costs less because parts are interchangeable and good dealer service is available close to any job location.



BELOW THE DAM SITE, a rugged Caterpillar D8 Tractor equipped with a No. 8A Bulldozer clears and levels land. Contractors were Morrison-Knudsen, Terteling, Macco, and Puget Sound Construction Co.

An aid to this standardization program is the fact that leading manufacturers of excavators, compressors and other equipment can supply Cat Engines in the machines they build.

When this rugged equipment has completed its job, the imprisoned waters of the Boise River Canyon will be a key to a new farm empire, free from the menace of flash floods.

Caterpillar equipment will have carved out a new, richer life for some 100,000 Idaho citizens.

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The line you see above is the South Coast Conduit near Santa Barbara, California, designed by the U. S. Bureau of Reclamation. It utilizes over 75,000 feet of 27" and 30" American Concrete Cylinder Pipe and over 50,000 feet of 48" Lock Joint Concrete Cylinder Pipe, both manufactured especially for this pipe line by American Pipe and Construction Company.

The South Coast Conduit snakes over and through the mountains east of Santa Barbara, California . . . as a part of The Cachuma Water Project. Engineers specified Reinforced Concrete Pressure Pipe for this great water supply project which will provide for the future water needs of the Santa Barbara area.

LET OUR EXPERIENCE HELP YOU

Our 50 years of experience in design and manufacture . . . and our continuing program of research and development in this field . . . are available in helping your community plan its water projects wisely.

Direct your inquiries to any of our plant offices, and be assured of an immediate reply . . . plus informative bulletins on the type of reinforced concrete pressure pipe that will best meet your needs.

DESIGNED TO ENDURE

Reinforced Concrete Pressure Pipe, used on this important installation, has a high resistance to corrosion and oxidation. The steel, being embedded in a dense concrete wall, is not exposed to corrosive agencies . . . the concrete actually increases in strength with age. The combination of these two features produces a pipe of great strength and durability which, when placed in service, becomes a permanent installation requiring little or no future servicing.

The ease with which Reinforced Concrete Pressure Pipe is installed and joined, using standard contractor's equipment, is an important economy factor which should be considered when appraising the comparative costs of various classes of pipe.

This pipe has initial and *sustained* high carrying capacity. Its smooth interior walls insure against future loss of capacity and eliminate costly cleaning and relining work.

Reinforced Concrete Pressure Pipe is, in every sense, a pipe designed for a long useful life . . . a PERMANENT and economical part of water supply lines which are designed to endure.

FOUR PLANTS TO SERVE YOU

American manufactures four classes of reinforced concrete pressure pipe in diameters ranging from 12 inches to 12 feet, and for all pressures related to modern American water works practice.

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Concrete Pipe for Main Water Supply Lines, Storm and Sanitary Sewers, Subaqueous Pipe Lines

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Dozens of Uses • Thousands of Users
Prove Ability, Versatility of the Model D

40 Brake hp. • 8,800 lb. (bare)
Four speeds forward to 25.6 mph., reverse to 3.3 mph.

The thousands of satisfied owners are still finding new uses for the able and versatile Allis-Chalmers Model D Grader. It has proved again and again that it has the power and capacity to do outstanding work on both construction and maintenance.

Usefulness of the Model D is multiplied by several easily mounted attachments: hydraulically controlled rear-end loader, shoulder maintainer that is interchangeable with the loader, scarifier, both V-type and blade snowplows.

MORE POWER, NEW FEATURES, LOW COST

For even greater performance ability, power for the Model D has been boosted to 40 brake hp. Also, leaning front wheels and power circle turn now are available (optional). With these and other big-grader features such as tandem drive, ROLL-AWAY Moldboard, tubular frame and hydraulic blade lift — the Model D's original cost still is but one-third that of a large grader. Operating costs are low, too.

Your Allis-Chalmers dealer will be glad to demonstrate what the versatile, economical Model D can do for you.

ROLL-AWAY is an Allis-Chalmers trademark.

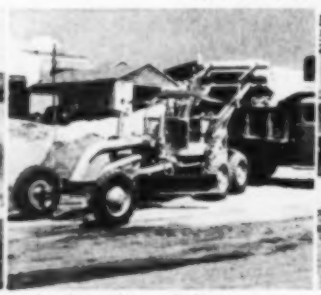
ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

...for contractors

Finish grades between forms on road and street construction.

Levels for home building, parking lots, play areas, etc.

Terraces, builds diversion ditches, does miscellaneous grader work.



Loads sand, gravel, dirt, any material, with ⅜-yd. bucket.

Rough grades, spreads and cleans up on street or road construction.

Landscapes, grades lawns, slopes, ditches around housing projects.

...for county and state highway departments

Scarifies with plenty of down pressure, accurate hydraulic control.

Mixes thoroughly, with rolling action of ROLL-AWAY moldboard.

Cuts and cleans ditches, slopes banks, grades shoulders.

Reshapes and maintains shoulders with rear-mounted attachment.

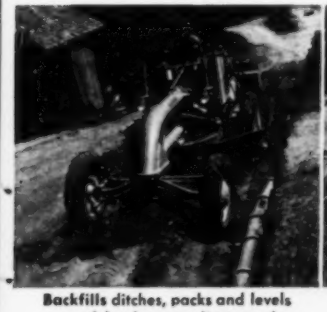
Loads sand, dirt, snow—any material — to trucks.

Keeps roads in shape the year-round — clears snow in winter.

...for cities towns and townships

Maintains streets and alleys, park drives, playgrounds.

Handles light construction on streets, roadways, etc.



Backfills ditches, packs and levels ground, loads excess dirt to trucks.

Removes weeds from street sides and alleys, loads or hauls away.

Windrows snow with blade, or plows with V or blade plow.

Loads snow from gutters, maintains stockpiles, handles bulk materials.

...and others

Builds and maintains access roads for quarries, cemeteries, etc.

Clears and loads snow at quarries, storage yards, parking areas.

Grades, handles bulk materials around industrial plants.

Hustles with

Railside commercial site prepared fast by pair of International TD-14As

"THEY'RE POWERFUL AND FAST," owner Harold J. Anderson tells reporter in describing the performance of his two TD-14As.

the Pay Load

"My TD-14As self-load six pay yards and deliver it faster than any crawlers the same size on the market."

That's the flat statement of contractor Harold J. Anderson, out on the job where his tractors are filling and leveling a building site at Minot, N. D.

Whatever size of crawler fits your needs, there's an International model that'll come through with power, maneuverability, and good steady work, day in and day out.

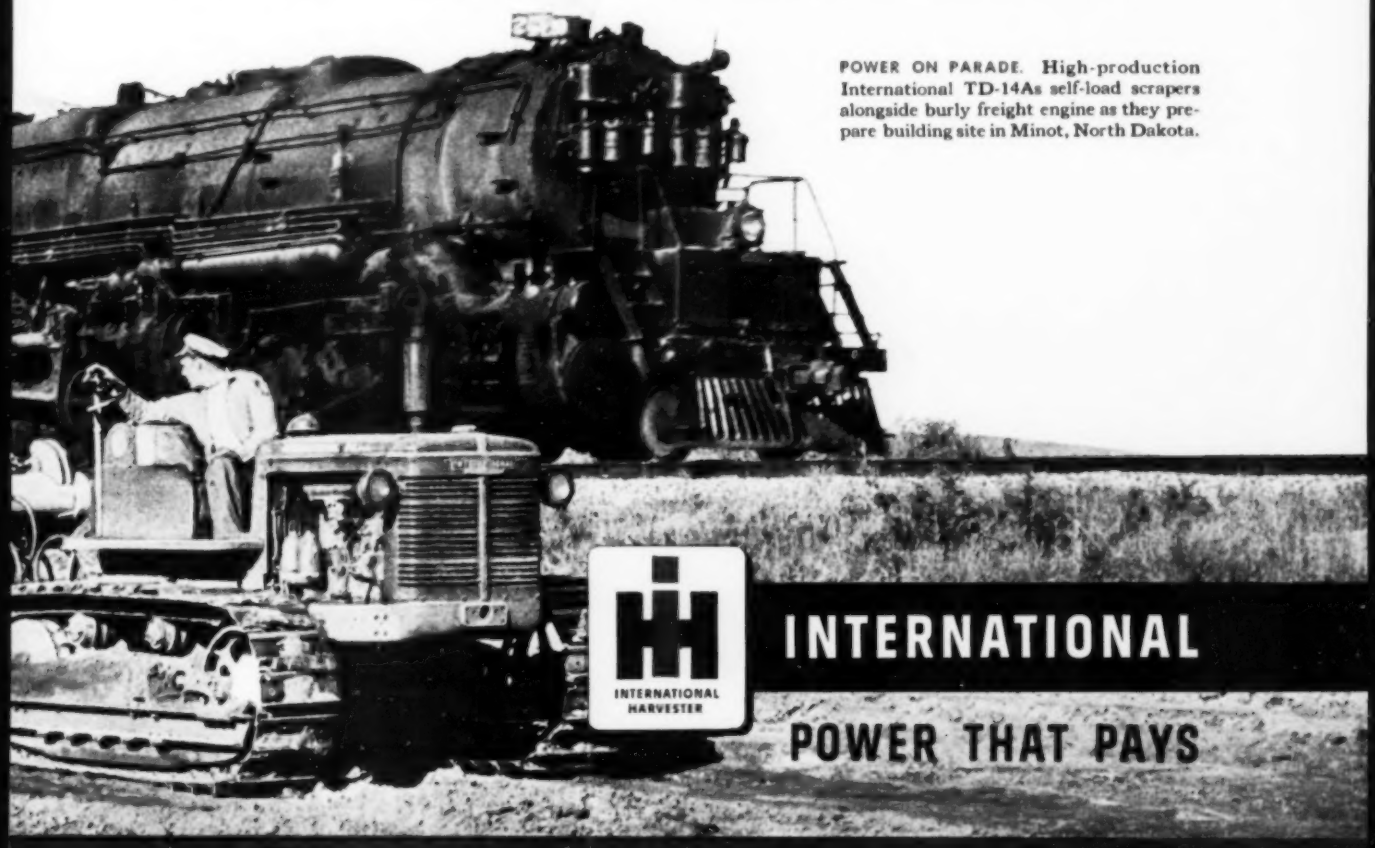
Here's what Anderson says on this point:

"I've been using Internationals for four years with very low maintenance and operating costs. In fact, my first International ran three full years with no downtime for repairs."

This kind of report comes from contractors all over the country—proof that International builds real dirt-moving machines that stand the gaff.

So see the International Industrial Distributor located near you. He has the full line of International crawlers—and as a nearby source of parts, trained servicemen and complete shop facilities, he can help keep your equipment easy on the overhead for years to come.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILLINOIS

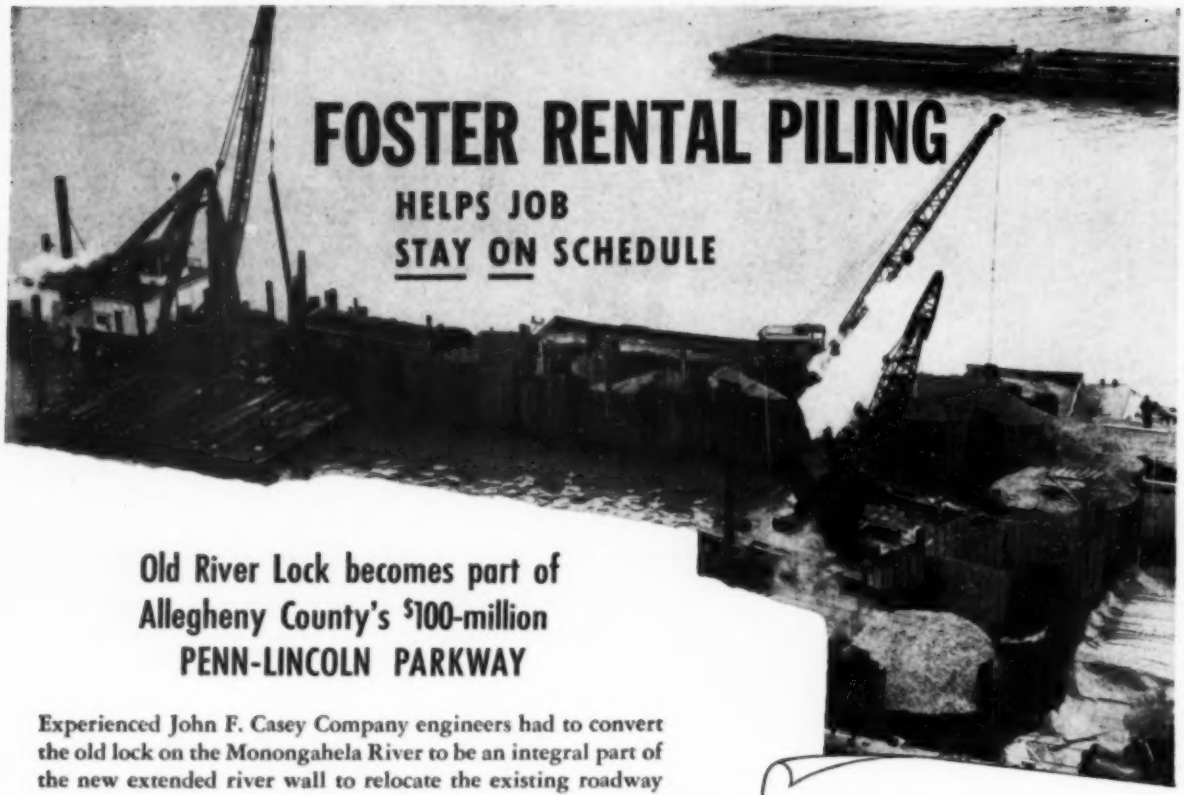


POWER ON PARADE. High-production International TD-14As self-load scrapers alongside burly freight engine as they prepare building site in Minot, North Dakota.

INTERNATIONAL HARVESTER

INTERNATIONAL

POWER THAT PAYS



FOSTER RENTAL PILING

HELPS JOB STAY ON SCHEDULE

Old River Lock becomes part of Allegheny County's $100-million PENN-LINCOLN PARKWAY

Experienced John F. Casey Company engineers had to convert the old lock on the Monongahela River to be an integral part of the new extended river wall to relocate the existing roadway and accommodate the new Penn-Lincoln Parkway. Casey engineers drove cellular cofferdams averaging 23'9" in diameter to keep water seepage to the minimum on this tremendous engineering project. Their careful planning insured an efficient, uninterrupted work schedule in constructing the river wall, and an important part of the schedule depended on Rental steel-sheet Piling from Foster. Foster delivered ahead of schedule, in the exact sections (MP-112) and in the specified lengths.

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CONTRACTORS
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- effects of air-entrainment on the plastic state
- factors affecting the amount of entrained air
- advantages of entrained air in mass concrete
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- freezing and thawing resistance
- compressive and flexural strength
- bleeding tests of air-entrained concrete

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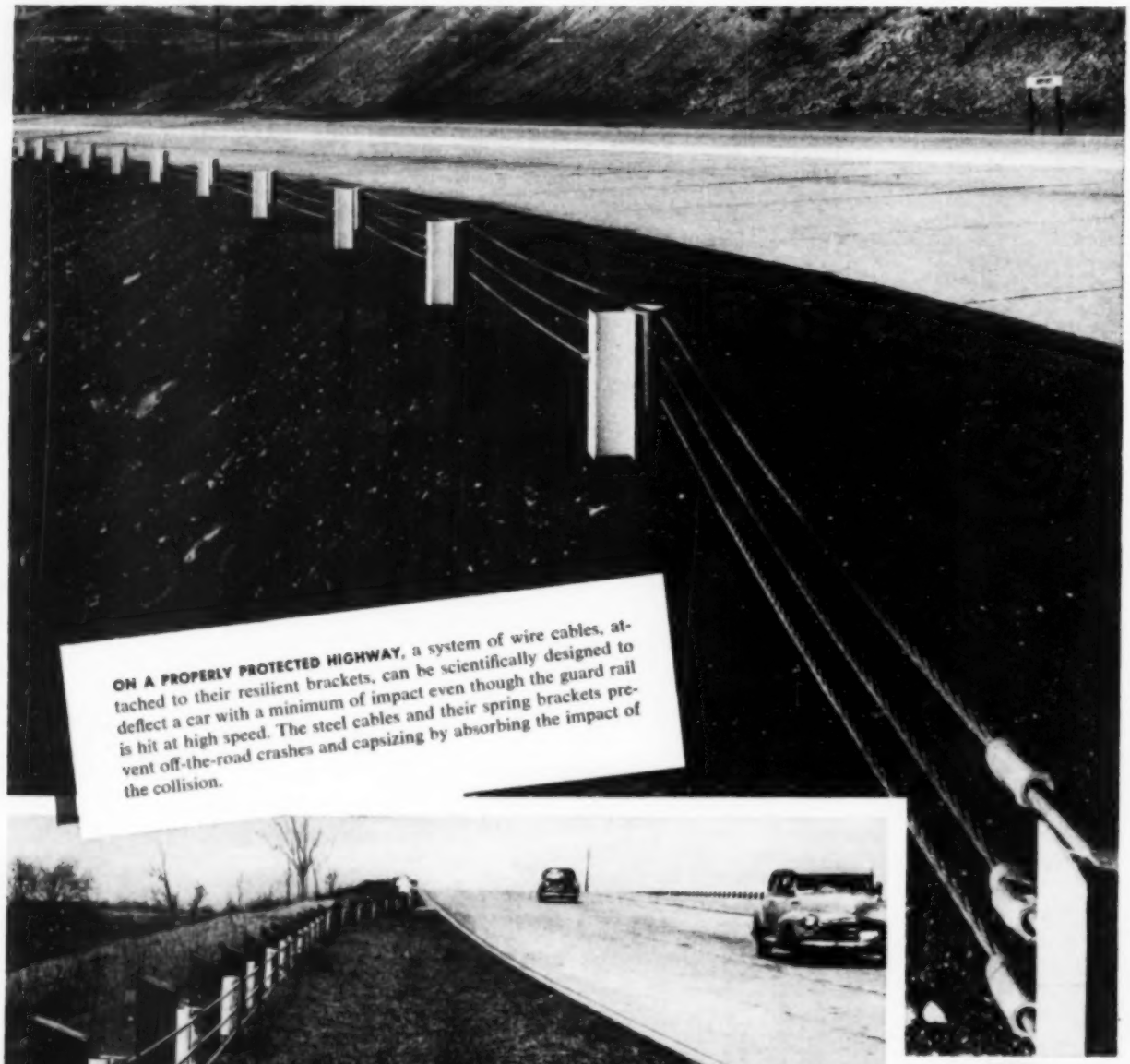
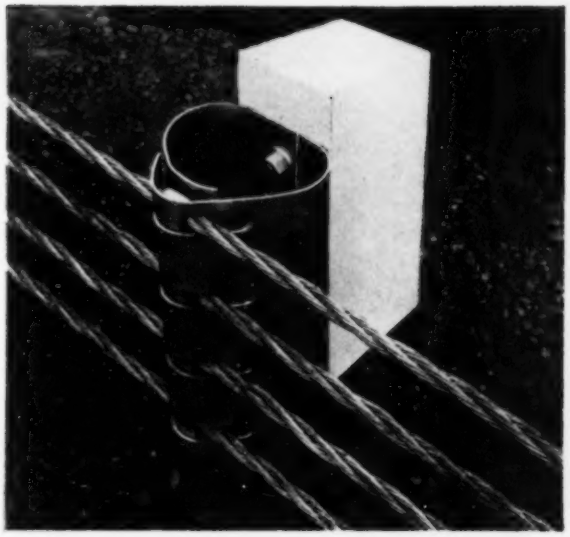


ON A PROPERLY PROTECTED HIGHWAY, a system of wire cables, attached to their resilient brackets, can be scientifically designed to deflect a car with a minimum of impact even though the guard rail is hit at high speed. The steel cables and their spring brackets prevent off-the-road crashes and capsizing by absorbing the impact of the collision.

USS

High Speeds
CABLE GUARD



OVER 140 impact tests, on many types of Guard Rails and using cars of all types, have proved that American Multisafty Cable Guard provides greater protection to cars traveling at high speeds. At our Worcester, Massachusetts proving grounds, various guard rails were struck by speeding automobiles. Stresses in these rails were measured at the time of impact. The data derived from the tests are now available to aid in designing a highway guard for *definite miles per hour protection.*

Multisafty Highway Guard Cable is most effective from the standpoint of preventing injury to life, damage to the vehicle or to the guard rail itself.

Although safety is paramount with Multisafty Cable Guard, economy, too, must be considered. 3 or 4 Cable Multisafty Guard Rails are low in cost of construction and maintenance. The galvanized wire and cable brackets do not require periodic painting, since they are corrosion resistant. The posts may be removed readily and replaced without disturbing the cables. Multisafty Cable Guards are extremely simple to install and maintain, since they require no skilled labor, a minimum of tools and are not difficult to handle.

When you are planning high-grade, low-cost protection for highway traffic in your area, get in touch with our nearest sales office for complete information on Multisafty Cable Guard. We will be glad to supply you with literature on how to design a guard rail system scientifically for *definite miles per hour protection.*

MOTORISTS on the Henry Hudson Parkway in New York rely on these scientifically engineered guard rails to keep them on the road when unforeseen emergencies occur.

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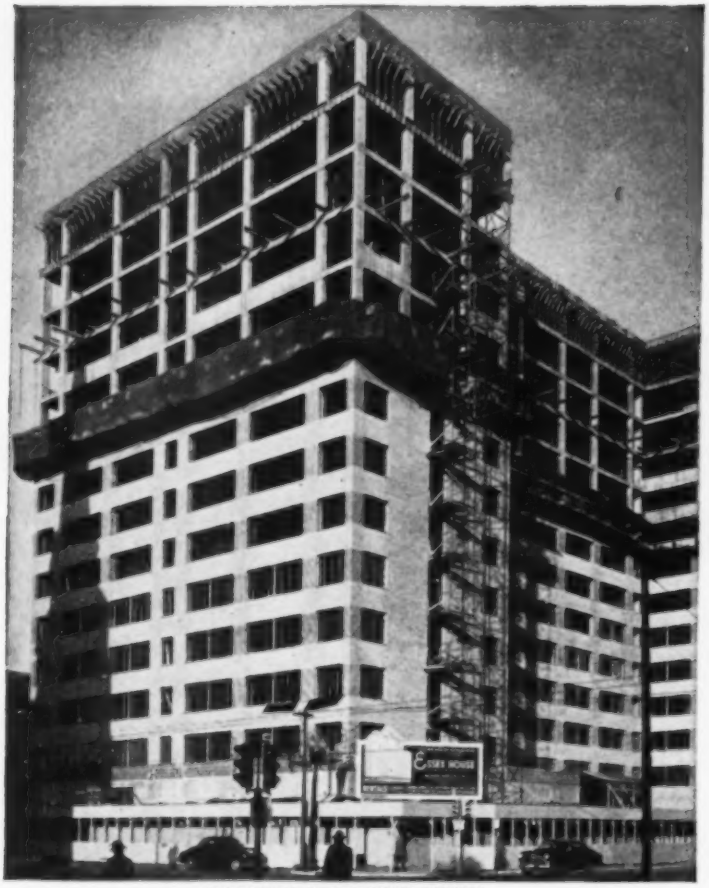
UNITED STATES STEEL



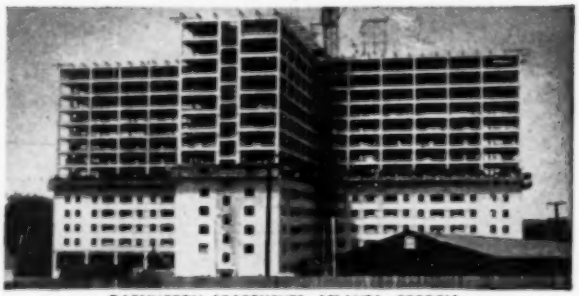
ESSEX HOUSE, INDIANAPOLIS, INDIANA

MARINE DRIVE APARTMENTS, CHICAGO, ILLINOIS

DANTE PLACE HOUSES, BUFFALO, NEW YORK

QUALITY HILL TOWERS, KANSAS CITY, MISSOURI

MANHATTAN APARTMENT HOUSE, NEW YORK CITY



DARLINGTON APARTMENTS, ATLANTA, GEORGIA

Concrete Frames and Floors

...QUALITY CONSTRUCTION FOR MODERN APARTMENT HOUSES

These buildings show the widely growing use of reinforced concrete frame and floor construction for apartments. There are many reasons for the increasing popularity of this type of construction.

It offers durability, great strength, firesafety and economy. Cost analyses and competitive bids over the country show it saves up to 40% on frame and floor cost. Its moderate first cost, small maintenance and long life add up to ***low annual cost,*** which pleases owners and investors.

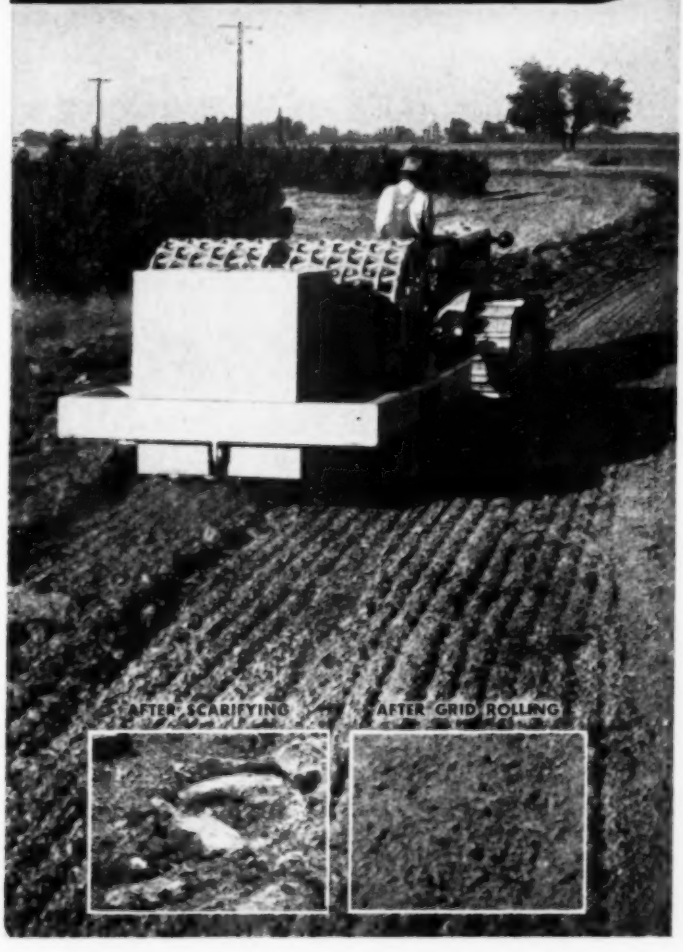
For help in designing and building reinforced concrete frame and floor apartment buildings write for your copy of free, illustrated literature. Distributed only in the U.S. and Canada.

PORTLAND CEMENT ASSOCIATION

DEPT. A6-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

Repair or Rebuild
roads and streets the modern way ...the GRID ROLLER way for faster salvaging of black-top at less cost!



No other single piece of road building equipment can match the Hyster Grid Roller in dollars returned per dollar invested! Progressive road builders and officials of counties, townships and municipalities throughout the country are adopting the Grid Roller method because it results in a *better* job, yet makes possible *substantial* savings. For limited or fixed budgets this means *more miles of road can be repaired or rebuilt.*

Key to savings is the fact that the Grid Roller performs three functions: (1) salvages the old surface material, (2) compacts the base, (3) rolls the new surface. On the job illustrated here, for example, involving only 1.6 miles of rebuilt road, savings approximately *matched the cost of the Grid Roller!*

A new 16 MM sound motion picture will be available soon showing the Grid Roller in action on different types of black top jobs, including the job illustrated here. Make arrangements now to see this motion picture at your Caterpillar-Hyster dealer, or write for information to:

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HYSTER

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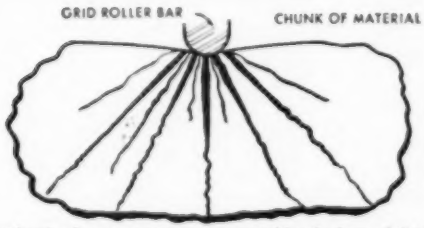
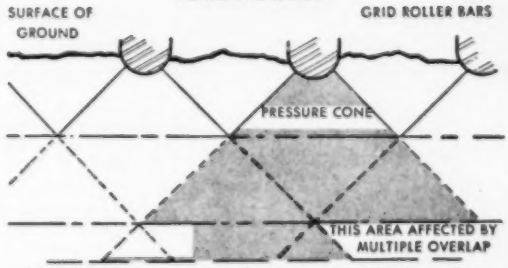
THE GRID ROLLER PRINCIPLE IS EQUALLY EFFECTIVE FOR:

BREAKING UP BLACK TOP



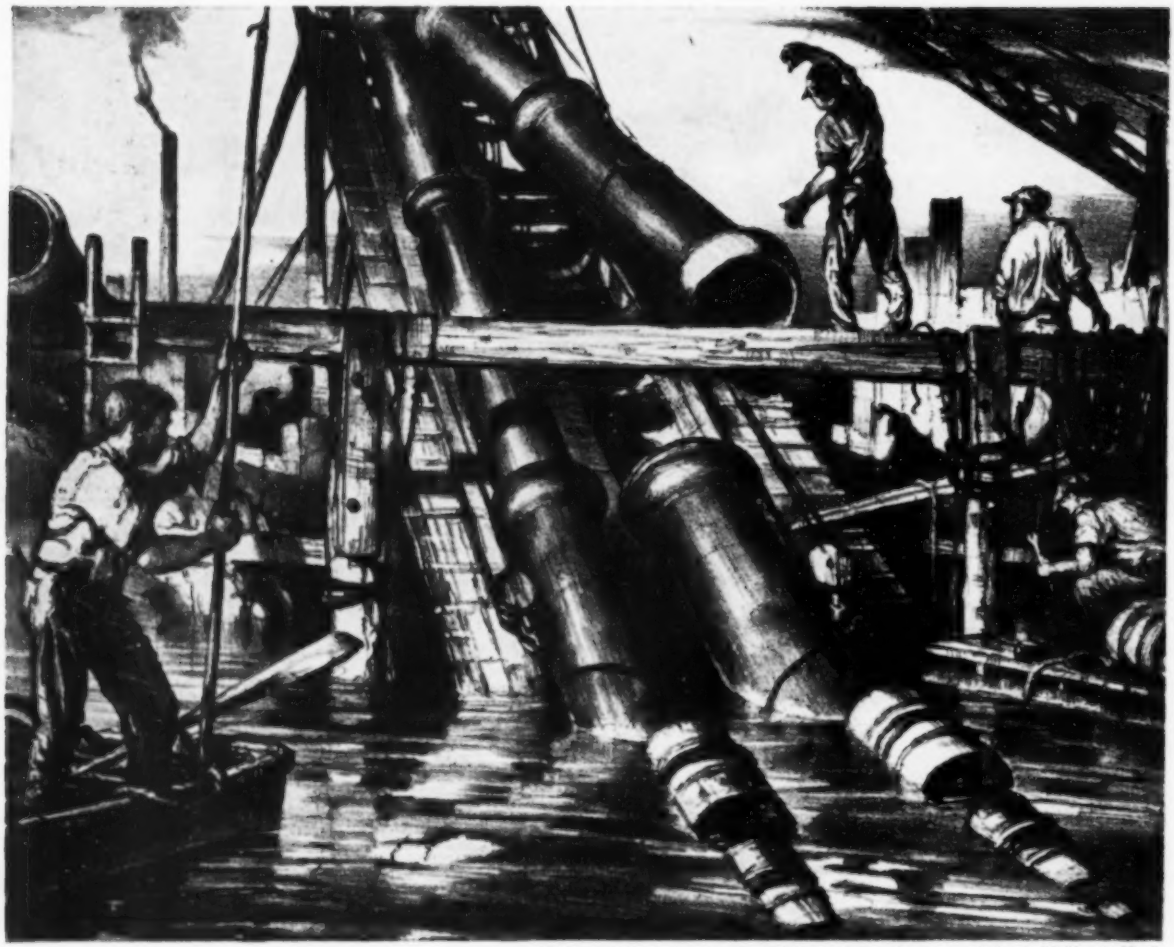
Impact loads of up to ten tons are exerted by the bars of the Grid Roller on chunks of material, thus immediately breaking piece—or causing fractures which break apart easily on the next pass.

COMPACTION



Note how "pressure cones" compact material from the bottom up!

HYSTER® COMPANY • PORTLAND, OREGON; PEORIA, ILLINOIS; NIJMEGEN, THE NETHERLANDS



Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

WHEN A CAST IRON water, gas or sewer line crosses a stream flexible joint pipe is frequently used. Joints that will deflect enough to meet installation and post-installation conditions and remain tight are most important in a submarine installation.

U. S. flexible joint pipe in all sizes, and pipe 30-inch and larger with other types of joints, are produced by the *pit cast* process. In sizes 2-inch through 24-inch, U. S. pipe is cast *centrifugally* in metal molds with bell-and-spigot, mechanical joint or plain ends

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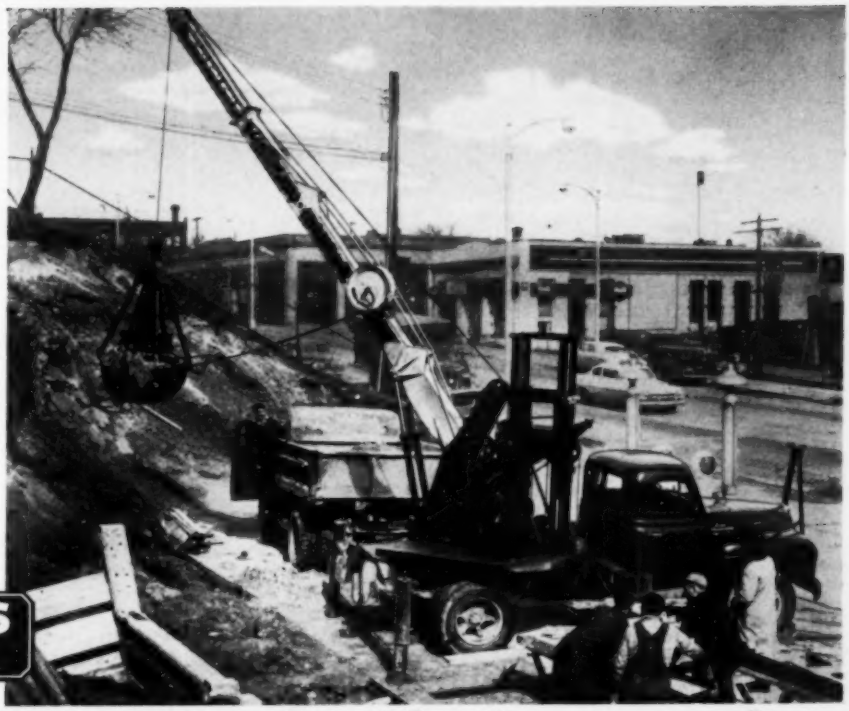

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HYDROCRANE'S built-in reach grabs the "EXTRA-DOLLAR" jobs

Bucyrus-Erie Hydrocrane with hydraulically telescoping boom gives you 8 ft. more boom — right at your fingertips. This special extend-retract action means extra dollars in savings on regular jobs . . . extra dollars in profits on special jobs ordinary outfits can't handle. Look:

1. *On erection work* boom reaches between girders . . . hoists concrete buckets, planking, etc., to upper stories . . . saves hundreds of man-hours.
2. *On road work* telescoping boom reaches under branches, over obstructions while handling pipe, culvert, or levelling shoulders . . . moves material into tunnels and low underpasses . . . handles dozens of close-quarter jobs.
3. *On yard work* reaches into boxcars . . . over fences . . . between stockpiles to move material, load trucks, etc., in a hurry.

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By actual stop watch test, crane has been converted to drag-shovel front end by one man in *less than one hour!* And on trenching, telescoping action of Hydrohoe boom cuts lost time moving up as much as 40 percent.

Get the full story on the all-hydraulic Hydrocrane with its many attachments.
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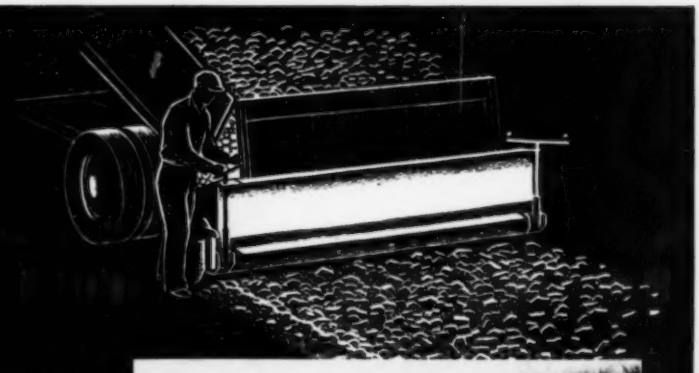
Tonnage is UP
at the quarry...

Costs are DOWN
on the job...



Typical Bitumuls Full Penetration Macadam Pavement

when Penetration Macadam roads are built with Graded Aggregates and BITUMULS®

HERE'S HOW ROAD-BUILDERS avoid the expense of placing and compacting base rock, choke stone and key stone *separately* in the construction of Penetration Macadam.

Quarry owners are able to make a blended aggregate that has been *graded at the quarry* to provide the specified percentage of each size of stone that assures close interlocking when compacted. The result is higher production for the quarry; savings in time and labor for the Road-Builder; better roads at lower costs for the city, county or state.

WHY BITUMULS?

Graded aggregate, properly placed and compacted, forms a dense mass with a minimum of voids. *Only* Bitumuls—applied cold—can *completely* penetrate this dense, closely-interlocked mass, coating each stone with a thin film of pure asphalt. This provides a mud-and-water seal for the pavement base and maintains the maximum bearing strength that is inherent in Bitumuls Full Penetration Macadam.

Full Penetration Macadam is suitable for either new construction or for resurfacing existing pavements.

There are Bitumuls Engineers working out of plants near you. They welcome an opportunity to furnish details on this method of pavement construction, or to discuss other paving problems. From these same plants, Bitumuls in both Quick-Setting and Mixing Grades is available for prompt, on-job delivery.

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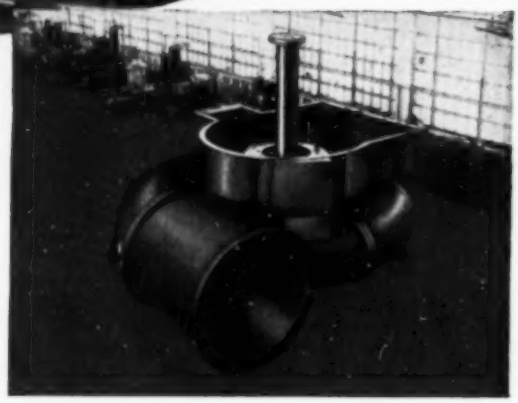
The *"Anderson Ranch"* POWER PROJECT
United States Bureau of Reclamation



hydraulic turbines by **LEFFEL**

Anderson Ranch Dam, located on the Boise River in Idaho, U. S. A., is the highest earth-fill dam in the world. Two Leffel turbines are installed in the Anderson Power Plant which provides power for the surrounding area. The turbines are of the cast steel spiral case, vertical Francis type and each is maximum rated at 28,250 HP, under 324 ft. net head, speed 277 RPM.

With a structural height of 456 feet, a base width of 2,650 feet and a crest length of 1,350 feet the Anderson Ranch Dam contains nearly 10,000,000 cubic yards of earth and rock. The reservoir behind the dam will hold 493,200 acre-feet of water.

When you consider turbines for your power project (whether it is a new installation or the expansion of an existing installation) we ask you to keep in mind the services which are offered by Leffel. Our 91 years of experience, our large modern plant, our thorough workmanship — all are ready to serve you.

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"CONCRETE JOIST FLOOR CONSTRUCTION WAS SELECTED BECAUSE OF ITS ECONOMY AND PERMANENCE"

LaRue Carter Memorial Hospital, Indianapolis, Indiana
Architects: Daggett, Naegele & Daggett, Inc.

DAGGETT, NAEGELE & DAGGETT, INC.
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1937 CENTRAL AVENUE
INDIANAPOLIS 2
INDIANA

ROBERT FROST DAGGETT, F.A.I.A.
ROBERT FROST DAGGETT, JR. A.I.A.
P. HAROLD NAEGELE, A.I.A.

March 30, 1953

Mr. Harry C. Delzell
c/o Concrete Reinforcing Steel Institute
38 South Dearborn Street
Chicago 3, Illinois

Dear Mr. Delzell:

Concrete Joist floor construction was used in the recently completed Indianapolis LaRue Carter Memorial Hospital. This type of construction was selected because of its economy and permanence.

With the use of Concrete Joists, material was saved and dead floor weight reduced. Consequently, smaller framing members could be used, appreciably lowering costs. Using prefabricated, removable forms saved construction time which also resulted in lower costs.

This permanent type of construction, monolithic and rigid, with all members poured in place, lessens deflections and vibrations and the attendant expensive maintenance. This construction stands up well under the normal stresses of use and weather as well as the possible impact of fire or shock.

The space between the concrete joists was used to house pipes and conduit where suspended acoustical ceilings occurred. In those locations not requiring flat ceilings, the exposed concrete joist floor construction was pleasing in appearance.

We are well pleased with the results.

Sincerely yours,

Daggett, Naegele & Daggett, Inc.

By Robert Frost Daggett
Robert Frost Daggett

CONCRETE REINFORCING STEEL INSTITUTE

38 S. Dearborn St.
Chicago 3, Ill.

Constructing a hot-mix Texaco Asphaltic Concrete pavement in two courses over old concrete on section of U. S. Route 31-E south of Louisville, Ky. Work done by the Breslin Construction Company of Louisville.

Same surface... different foundations

for these Kentucky State Highways

When Kentucky constructed these two highway projects near Louisville, the wearing surface laid on both highways was the same—two courses of hot-mix Texaco Asphaltic Concrete. In one case, the foundation which supports the asphalt surface is waterbound macadam; in the other, the existing cement concrete pavement on the highway provides an adequate foundation for the new surface.

A resilient, heavy-duty Texaco Asphaltic Concrete surface for street, highway or airport may be laid with excellent results on a variety of foundations. The two foundations recommended by our engineers as most desirable are coarse-graded asphaltic concrete (black base) and asphalt penetration macadam. However, such foundations as waterbound macadam and gravel, of adequate thickness and properly compacted, provide very satisfactory support for a Texaco Asphaltic Concrete top course.

Whatever your paving project, it is a good idea to investigate the various types of construction available to you through the use of Texaco Asphalt Cements, Cutback Asphalts and Slow-curing Asphaltic Oils. These types range from heavy-duty asphaltic concrete down to a low-cost surface for light traffic. We have published two booklets which supply helpful information regarding all of these types. Copies can be obtained with no obligation by writing our nearest office.

This heavily traveled hot-mix Texaco Asphaltic Concrete pavement on Kentucky State Route 61 at Louisville is supported by a waterbound macadam foundation. The contractor was the George M. Eady Company of Louisville.

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

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REG. T. M.

TEXACO ASPHALT

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This is the initial stage of the core-trench of the Earth Fill-Impervious Cutoff Dam now under construction at Kirwin, Kansas by the U. S. Bureau of Reclamation. Cook Construction Co. of Jackson, Miss. has the contract for this stage, which is 5000 ft. long, with a maximum depth of 90 ft. of which 60 ft. was below ground water table. Predominant soil characteristic —fine silt, quick when saturated.

By dewatering the excavation and stabilizing the side slopes with STANG WELLPOINT SYSTEMS, the contractor was enabled to

- Excavate to payline with over-excavation at a minimum.
- Use high speed money making equipment for minimum excavation cost.
- Place backfill conforming strictly to specified moisture content and compaction requirements.

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Because it is designed for

continued high carrying capacity** and **will not tuberculate . . .

Transite Pressure Pipe

reduces the operating cost of your system

IT HAS BEEN PROVED again and again—through performance records—that Transite* Pressure Pipe reduces pipe line operating costs.

There's good reason for this. Because of Transite Pipe's smooth inner surface and asbestos-cement composition, its initial high flow capacity (C= 140) can never be reduced by tuberculation. This absence of tuberculation is an assurance that a full flow of water will be maintained for years to come. Pumps can be operated closer to peak efficiency; therefore pumping costs can be held to a minimum.

There are many other ways in which Transite Pressure Pipe cuts costs, too. For example:

- It enables the use of smaller pipe sizes—because systems can be designed without allowance for future flow reduction due to tuberculation.
- It is light in weight, easy to handle, fast and economical to install.
- Its factory-made joints are easily assembled, stay tight in service, reduce water losses.
- Its high corrosion resistance assures maintenance-free performance in a wide variety of soils.

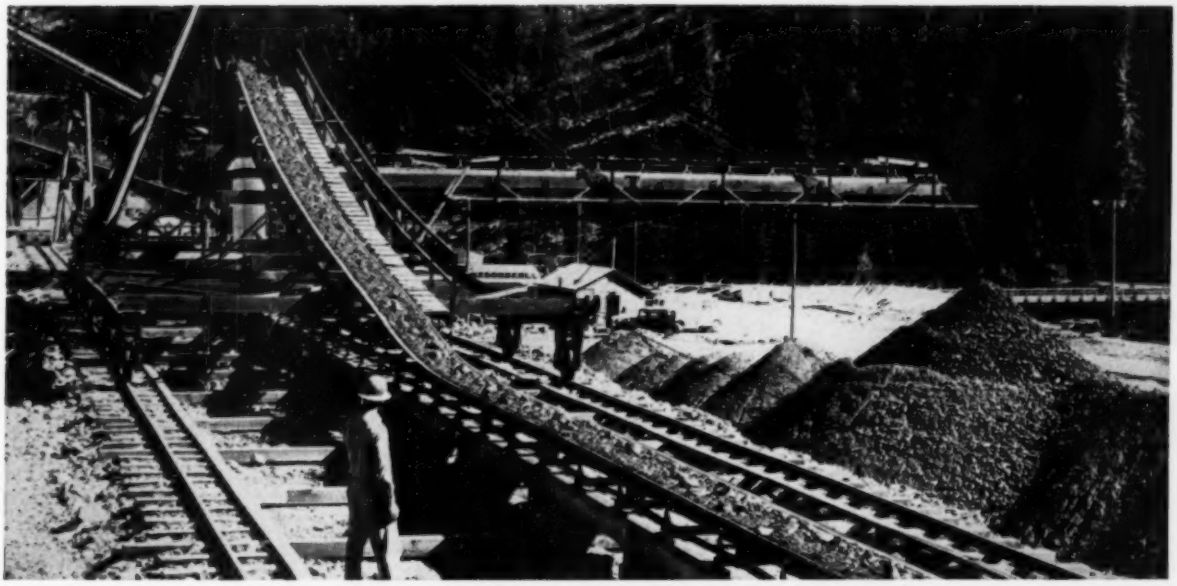
Why not find out more about this durable, cost reducing pipe? Many of its installation and operating advantages are illustrated in detail in our Pressure Pipe Brochure TR-11A. For your copy, write Johns-Manville, Box 60, New York 16, New York.

*Transite is a Johns-Manville trade mark.

How Transite Pipe piles up savings on . . .

The savings Transite Pipe has effected because of its corrosion resistance, high flow capacity and long life are being realized today by thousands of community water systems, and Federal, state and industrial installations throughout the country.

Johns-Manville TRANSITE ASBESTOS-CEMENT PRESSURE PIPE



From this Link-Belt 850-ft. long belt conveyor, raw materials for stockpiling near gravel preparation plant are discharged by Link-Belt tripper onto wing conveyor.

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LINK-BELT builds a complete line of belt conveyor components

ALL TYPES OF ROLLER BEARING IDLERS

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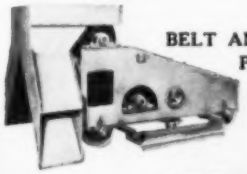
45° troughed idler

Belt-training idler

20° troughed idler

Return idler



BELT AND MOTOR PROPELLED TRIPPERS

COMPLETE TERMINAL MACHINERY

Twin-Swing-Span Bridge

Latest Forward Step Linking Tidewater Virginia

● Newest traffic crossing to pull together water-separated areas of Tidewater Virginia is this $9-million Bridge over the York River.

Said to be the world's largest twin-swing-span structure, it is 3,750 ft. in length, with two 500-ft. swing spans. Cantilever over-water construction is supported on six giant caissons built at Newport News Shipbuilding & Dry Dock Co., and floated to bridge site.

Caissons, 95 to 110 ft. in height, were sunk approximately 70 ft. into river bed, with tops about 40 ft. under water. Towering 90-ft. pier shafts were built by means of cofferdams on top of the caissons.

The Bridge has a 26-ft. clear roadway, with two safety walks for pedestrians. A total of 50,000 cu. yds. of concrete was used in the piers and deck.

Construction of this great Bridge, in a broad, deep, swift-flowing river, ranks this as an achievement of high order, another monument to engineering and construction skills.

Into the bridge proper, approaches, toll plaza and administration building went a total of 99,796 barrels of Lone Star Cement, every barrel of it the always-dependable high quality that makes Lone Star a fitting material with which to translate engineering vision into economical, durable reality.

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CIVIL ENGINEERING

JUNE 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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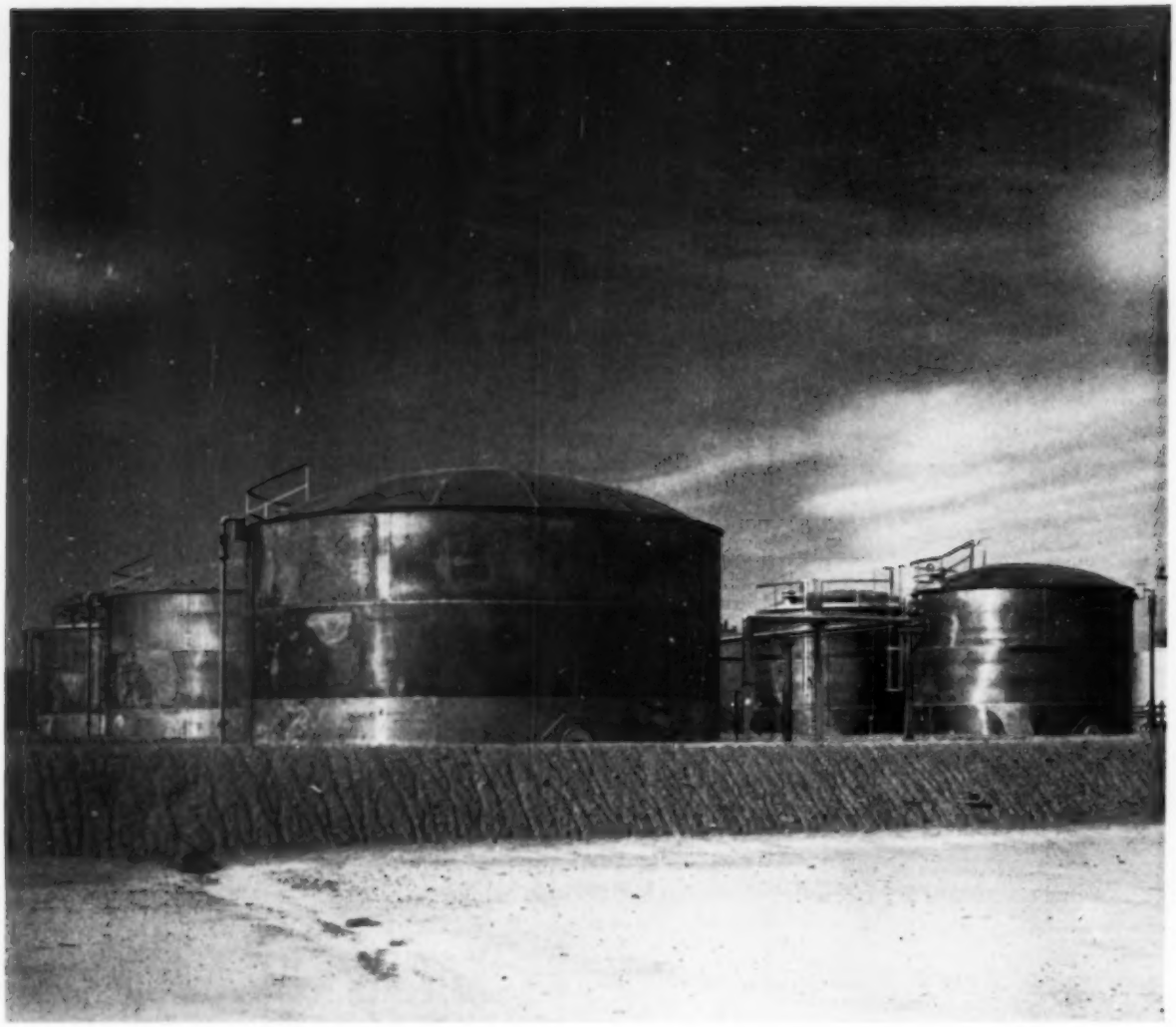

Horton* Aluminum Storage Tanks for USI

Five Horton aluminum tanks were installed at the new plant of the U. S. Industrial Chemical Co. Division of National Distillers Products Corp. near Brownsville, Texas. Three of the tanks, 35 ft. diam. by 18 ft., handle acetic acid. The other two, 23 ft. diam. by 18 ft., are used to store propionic acid. All five are flat bottom, umbrella roof structures, made entirely of aluminum plates.

The three 120,000-gal. acetic acid tanks are designed to handle 16,000,000 lbs. per year of glacial acetic acid, a synthetic chemical produced during the recovery of liquid hydrocarbons from natural gas. The propionic acid stored in the two 50,000-gal. tanks is, like acetic acid, a valuable commercial chemical produced from natural gas at the USI plant.

During the erection of these Horton aluminum tanks, a Chicago Bridge & Iron Company Field Welding Supervisor was assigned to the job to instruct welding personnel, check welding equipment and supervise the cutting and grading of plugs. It was his job to see that all the requirements set forth in the specifications were met. Field supervisory service of this type is standard practice on all Chicago Bridge & Iron Company structures. We provide this extra inspection at no additional cost to assure you of the highest possible standards of workmanship and the best tank your money can buy.

Quotations on tanks made of carbon steel, aluminum or other corrosion-resistant metals may be had by writing our nearest office. There is no obligation on your part.

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CIVIL ENGINEERING

JUNE 1953

THE MAGAZINE OF ENGINEERED CONSTRUCTION

Extension to California's State Capitol follows traditional architecture of original structure. Although same height, new structure has two more floors.

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California Department of Public Works

Sacramento, Calif.

Grid-type footings support California State Capitol Extension

Clayey silt underlying the California State Capitol building in Sacramento led designers of the new extension to tread softly. The design of the new structure clearly shows their efforts to reduce soil loads since pile driving might have damaged the old brick-masonry walls. The grid-type footing and the unconventional framing proved to be the answer to this ticklish problem.

The new extension adjoins the old Capitol Building on the east and its exterior design follows the traditional architecture of the old building, although it functions as a modern office building complete with air conditioning and under-floor communication ducts. While it is the same total height as the old structure, it has two more floors. Fireproof construction has been used throughout, the structural steel frame being entirely covered with concrete, and no dependence being placed on plaster to protect the steel.

Foundation Is Clayey Silt

The soil directly under the footings of the old Capitol Building is composed of clayey silt, as was ascertained by excavating to the bottom of several existing piers. A soil investi-

Grid type of concrete footing supports extension. Usual procedure of driving piles through clayey silt to gravel stratum lying some 30 ft down was not followed because designers feared driving operations would disturb foundations of old structure and seriously damage its brick-masonry bearing walls.

gation on the site of the new extension indicated that the same material existed at the level of the new footings and had a thickness of some 30 ft to the underlying gravel many feet in thickness.

The old California Capitol Building is of the same period as the National Capitol in Washington, and the builders attempted to carry practically all loads by brick masonry in compression. The structure is divided into cellular units by brick and granite outside walls and interior brick cross-partitions and corridor walls which support floors of brick arch construction sprung between wrought-iron beams. The wall thicknesses were probably established by judgment based on experience and the footing widths also were probably determined by judgment.

There are no plans in existence from which to compute the weight of the old structure and thus determine the induced soil pressure, and it is believed that uniform soil pressure is only roughly approximated. Normally the California Department of Public Works would use piles driven to the underlying gravels to support a building such as the new capitol extension on a soil like that found at this site. However, it was felt that in such a soil the vibrations set up by the driving of piles so close to the old structure would result in irreparable damage to it. Therefore the following criteria were set up to govern the structural design:

1. Piles should not be used and the allowable soil pressure should be limited to approximately 2,500 psf.
2. No part of the new building should be carried by the old building except local passageway connections.
3. A type of spread footing of approximately uniform width should be used which would result in the smallest possible total settlement and also minimize the differential settlement between individual columns.
4. The structural frame should carry vertical loads only and any lateral forces due to earthquake or wind should be carried by the concrete walls and floors acting as diaphragms.

In order not to disturb walls of existing structure, first-floor columns of adjacent wall are battered so as to rest on extension of footing grid. Similar posts near center of building are battered in opposite direction to balance horizontal thrust of these columns.

To satisfy requirement No. 3, a grid type of footing was used instead of the customary isolated square type, since this would tend to resist any tendency toward differential settlement between columns. The grids are continuous concrete footings approximately 6 ft wide and 3 ft deep extending between columns and reinforced as continuous beams.

In these continuous footings the usual problem of reconciling the upward reactions due to soil pressure with the support offered by the column loads was encountered. In extreme cases the widths of the footings were varied, and reasonable agreement between column load and soil reaction was achieved. The computations were of necessity tedious and involved a great deal of cut and try.

This type of footing proved to be very economical as the soil could be moved by mechanical means and the concrete placed without using forms. Periodic readings taken at various locations since completion of the footings have shown settlements averaging approximately $^3/_8$ in., which is well within allowable limits.

A live load of 100 psf was used in designing the floor to allow for file-storage loads. This includes the weight of partitions, which in general consist of steel studs and plaster. Where there are large file areas, the

100 psf will take care of normally loaded files placed back to back, with the usual access aisles.

Lightweight Concrete Used

Column spacing was governed by garage requirements in the basement and is in general about 25 ft each way. It was evident that the use of concrete floors of normal weight for these comparatively long spans would result in very large footings because of the low allowable soil pressure. Therefore a study was made of the possibilities of using lightweight concrete to reduce the weight of the floor construction, the depth of the steel floor framing, and what was more important, the column loads and therefore the footing sizes.

The use of a manufactured material named Rocklite proved very satisfactory and resulted in structural concrete weighing 90 lb per cu ft oven dry, and having a compressive strength exceeding 3,000 psi. This material, made in Ventura, Calif., is manufactured by burning shale to produce a graded spherical aggregate similar to rounded sand and gravel. The aggregate is presoaked with water and a small percentage of fine natural sand and an admixture is added to obtain workability. This same lightweight concrete (proportioned for 1,500 psi) was placed on top of the structural slab to a thickness of $3^1/_2$ in., and encloses a complete system of communication ducts on all floors. These ducts accommodate all telephone lines and power wires for operating various office machines. A feature of this type of concrete is its low shrinkage factor resulting in a minimum amount of cracking. Lightweight concrete was also used for the exterior walls and interior shear walls, but regular concrete with stone aggregate was used in the footings.

Because of the necessity of connecting with the floors of the old building, the story heights were limited. The ceiling heights were determined by the structural requirements and depths of air conditioning ducts.

A type of steel framing was designed in which the principle of continuity of girders at columns was used, resulting in a definite saving in tonnage and also permitting a considerable reduction in the thickness of the floor construction. The beams were placed on 8-ft 4-in. centers spanning 25 ft 6 in. between the double steel girders, framed as shown in Fig. 1. These girder spans are alternately cantilevered and continuous supported. In general, both beams and girders are of 15-in. I-beams. This cantilever system has been widely used in the past for the design of structural steel purlins in roofs but not to any great extent in floors.

Because of limitations imposed by the foundations of the old building, it was not possible to carry the columns in the adjacent wall of the extension directly to the ground. Therefore the columns in the bottom story were battered so that they rest on an extension of the footing grid. The thrust in the first floor induced by this batter is balanced by similar batter posts in a reverse direction near the center of the building.

Unique Design Saves Steel

It is believed that the problems posed in the structural design of the Capitol extension by the soil conditions, the wide spacing of columns, and the nature of the soil loading under the old building have been successfully solved.

The structural steel tonnage in the new structure is about 2,200 tons, or about 900 tons less than it would have been if ordinary stone concrete and a conventional type of steel framing had been used. While no overall estimates have been made of the savings in concrete and reinforcing in the footings due to the greatly reduced column loads, these savings are believed to be significant. However, it must be pointed out that the cost of the special lightweight concrete is considerably higher than that of conventional concrete. No cost figures showing the total difference between the actual and a conventional design have been prepared but approximate studies indicate an overall saving due to the design used. The important end achieved was the shallow depth of the floor construction and the workable, rational sizes for footings.

The State Capitol Extension was designed by the California State Division of Architecture under the general supervision of Anson Boyd, State Architect. D. C. Willett was Chief Construction Engineer, and the writer was Principal Structural Engineer in charge of structural design.

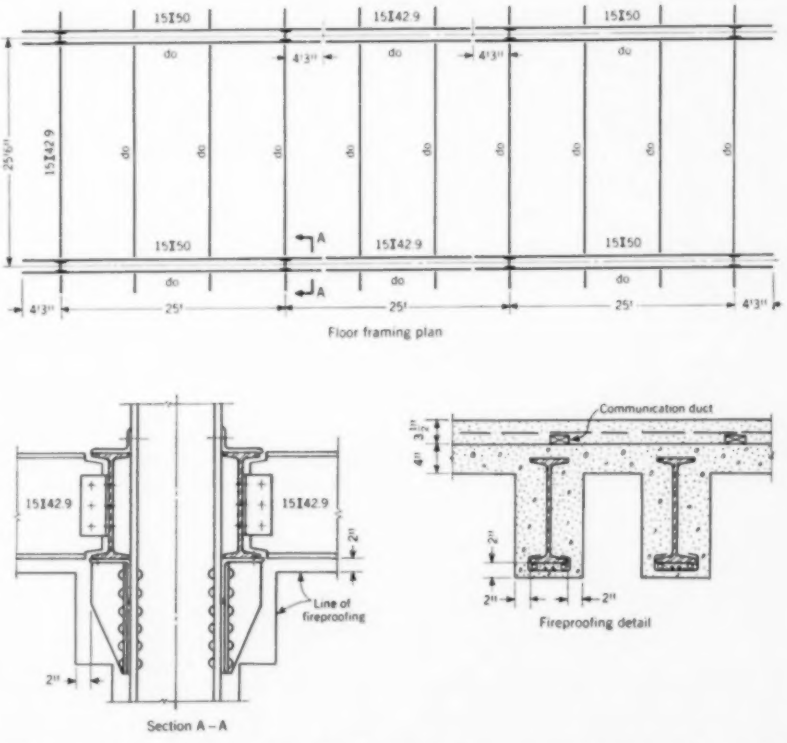


FIG. 1. Framing plan shows how girders of alternate bays were made continuous over column seats and cantilevered 4 ft 3 in. into adjacent bays. Section A-A shows framing at column. All concrete (except footings) is lightweight, made with manufactured aggregate called Rocklite. This concrete weighed 90 lb per cu ft, oven dry.

Half million

Intake structure houses screening and pumping operations at Johnsonville Steam Plant, here seen from access highway in April 1952, just after fourth unit was put in operation. Plant is on east bank of Tennessee River, or Kentucky Lake, about 75 miles west of Nashville.

To most civil engineers the great quantities of water required for condenser cooling in a modern steam-electric generating station are amazing. At TVA's Johnsonville Steam Plant the condenser for each 125,000-kw unit requires 106,000 gpm. This, together with cooling water for hydrogen and oil coolers and other station use, totals 112,000 gpm per unit, supplied by two condenser circulating water pumps.

The project was necessary to "firm up" the Authority's hydroelectric power system; it was planned, designed, constructed, and is being operated by TVA. Six units are operating, and construction is essentially complete for these presently authorized units.

Provision is made for an ultimate installation of ten units, which will require 1,120,000 gpm, almost 50 percent more water than is consumed by the city of New York from its public water supply. It is easy to understand why power plants are located adjacent to rivers or other large bodies of water, and cooling towers used only as a last resort.

Cooling Water Problem Still Unsolved

Mechanical engineers are justly proud of the present-day efficiency of a modern steam power plant such as TVA's Johnsonville plant (Fig 1). However, the gap between this efficiency and 100 percent is still very wide. Everyone is familiar with the stack losses; the evidence can be seen and so these losses are obvious. The great unseen robber of efficiency is the condenser cooling water. The temperature of each gallon is raised approximately 10 deg. This amounts to roughly 9,000,000 Btu's per min per 125,000-kw generating unit, which represents the burning of many tons of coal solely to generate fog and attract fish around the outlets during cold weather. In the list of needed scientific achievements, the elimination of this prodigal use of irreplaceable natural resources should take a prominent position.

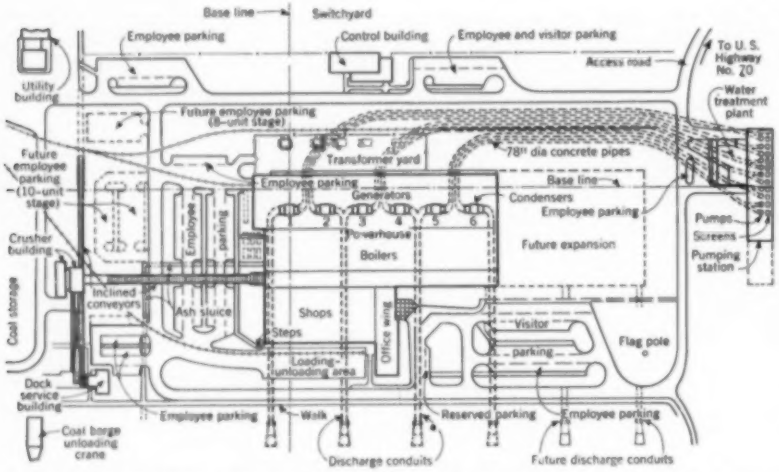
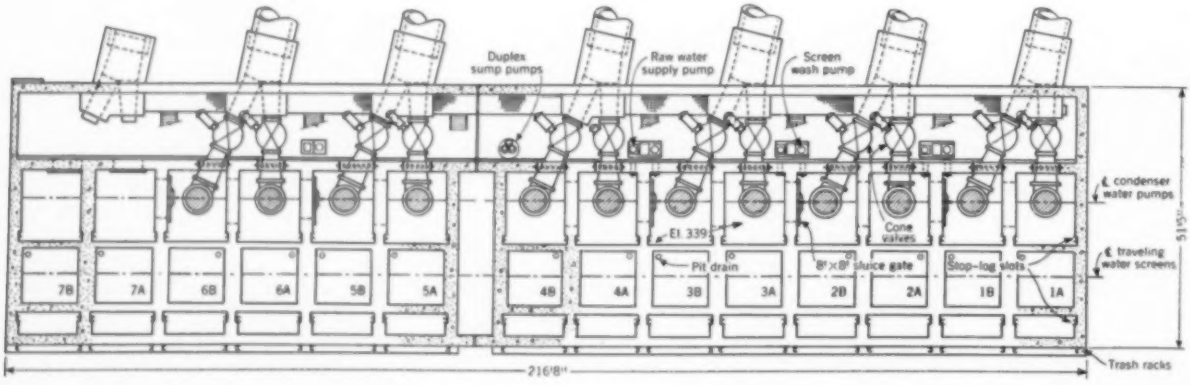


FIG. 1. Plot plan shows condenser-water flow from intake structure through supply pipes and powerhouse to point of discharge downstream from plant.

FIG. 2. Six units now in operation are seen in sectional plan of combined pumping station and intake structure for condenser cooling water. Entrance of supply conduits at slightly oblique angle was necessary to keep station on rock foundation.



gpm of condensing water used by TVA's Johnsonville Steam Plant

CLIFTON W. BOLIEAU, A.M. ASCE, Principal Mechanical Engineer, Division of Design, Tennessee Valley Authority, Knoxville, Tenn.

The purpose of this water is to cool, and thus condense, the steam as it leaves the last stage of the steam turbine, thereby reducing the pressure to within about 2 in. of mercury of a true vacuum and converting the steam to water for recycling in the boiler. In most of the older steam plants, it was customary to bring screened water by tunnel to the powerhouse with one or two pumps directly connected to the condenser inlet. This method required a structure at the river for the screens and space in the powerhouse for the pumps. This space is very costly and all of TVA's and most other modern plants now combine the screening and pumping operations in the river structure, with a pressure piping system to transport the heated water sufficiently far downstream to prevent recirculation. A plan and section of the intake structure for the Johnsonville Steam Plant appear in Figs. 2 and 3.

A simplified pressure gradient for the plant's condenser circulating water system is shown in Fig. 4. It is to be noted that the pumping head is composed of friction head only, because the water is pumped through a closed system from and to the same lake level. The condensers must be set low enough so that the negative head in the discharge water boxes is within reasonable limits. Vacuum systems are provided in both the pumping station and the powerhouse. The former is required only at low river stages but that in the powerhouse is in continuous use to vent the accumulation of air in the discharge water boxes and maintain them full of water.

Located for Maximum Efficiency

As shown in Fig. 2, the intakes enter at an oblique angle in order to keep the whole pumping station on a rock foundation. The station has to be low enough for sufficient pump and screen submergence at minimum river stage. Because the water is for cooling, design capacity has to be for high water temperatures and for low river stages, both of which usually occur during the summer. The water first passes through coarse racks to remove the large floating debris. The racks are set below curtain walls, the bottoms of which are at minimum water level. This setting aids in maintaining stratification of the water so that it will be drawn from the lower, and cooler, depths. It also seals the screen chamber from freezing weather in winter. The racks are cleaned by a rake operated from the gantry crane.

The water next passes through traveling screens of $^{3}/_{8}$-in. mesh. It is expected that everything passing the screens will pass through the entire system, for the smallest openings are the condenser tubes, of $^{7}/_{8}$-in. outside diameter. Differential pressure gages are provided to indicate the loss of head across each pair of racks and screens. Loss of head indicates degree of cleanliness and tells the operator when the screens or racks should be cleaned.

Vertical turbine pumps installed in separate wells adjacent to, and obtaining their water from, the main pump pits provide pressure water for screen washing. One pump is provided for each four screens, plus one spare pump. It is expected that only during the fall season, when an appreciable quantity of leaves and other debris are in the river, will the screens be operated continuously. Guides for slide gates are furnished on each side of the screens. These permit the isolation of either screen or both pumps for inspection or repair.

Why Mixed-Flow Pumps

The characteristics of mixed-flow pumps are ideal for condenser circulating water systems. Combined with their high capacity and high efficiency, they have a relatively flat brake horsepower curve, permitting start-up against a closed valve without seriously overloading the motor. Another point of major importance is the low shut-off head which permits the use of low-pressure water boxes on the condensers.

The discharge elevation of the pumps is such that they are submerged fairly often. To disconnect the discharge coupling would present a hazard if removal of the pump were necessary. The pumps are therefore of the "pull-out" type in which the outer column and discharge connection remain permanently in place. For repairs, the entire shaft, shaft tube, bowls, and impeller may be pulled out and a spare unit replaced for a minimum shutdown period. The pumps are water-lubricated with

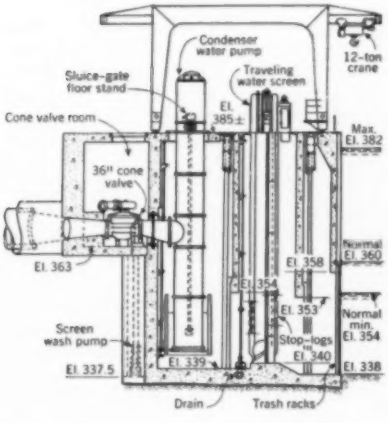


FIG. 3 (Left). Section through one unit of cooling-water pumping station shows combination of screening and pumping operations in river structure to effect saving in costly space.

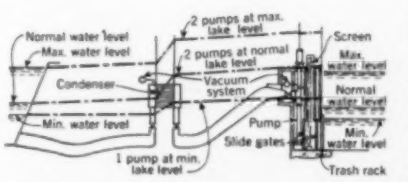
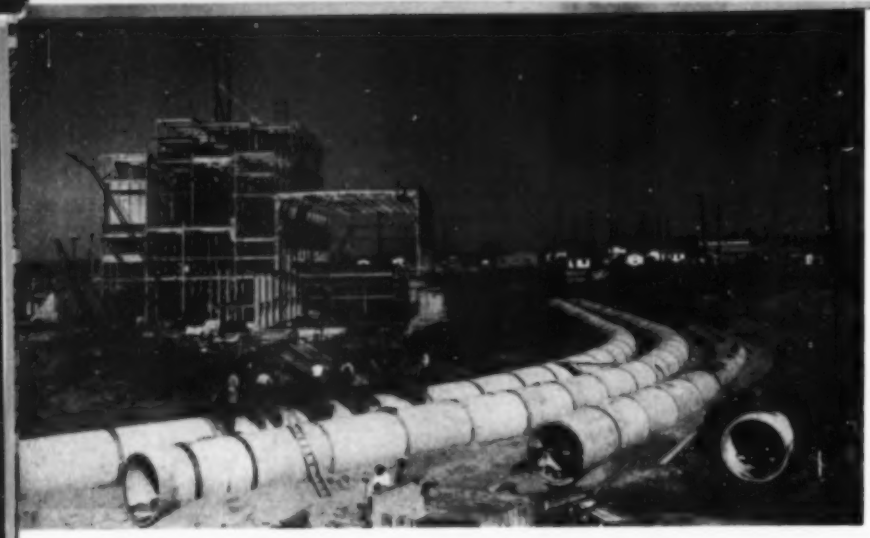


FIG. 4 (Above). Simplified pressure gradients are plotted for condenser circulating-water system. Pumping head in closed system is composed of friction head only.



Condenser-water supply pipes are laid for first four units. Reinforced concrete pipe sections have diameter of 78 in.

Conduits for condenser circulating-water are laid in powerhouse substructure.

Discharge conduit for cooling water has increasing outlet and well for stop-logs.

filtered water piped to a connection to the shaft tube at the motor base. The lubricating water first passes through an indicating meter with high and low alarm contacts. A low-flow alarm will notify the operator of water failure or stoppage within the pump, and a high-flow of a system break or bearing failure.

A 36-in. hydraulic-cylinder-operated cone valve is installed in a reduced section of the discharge piping. Power water for valve operation is obtained from the treated water system of the powerhouse. The valves are controlled by solenoid-operated pilot valves interlocked with the pump controls. Hydraulic-cylinder operation is preferred to electric-motor operation because of the need of varying the speed of opening and closing the valves within wide limits to suit the best operating sequence in starting and stopping the pumps.

At low river stages the hydraulic gradient is below the top of the pump discharge pipe. A vacuum system is therefore provided to maintain a full discharge pipe when the pumps are actually operating under a negative discharge head.

For each generating unit there are two pumps, each operating at the design capacity of 56,000 gpm and, with an average summer water temperature of 79 deg F, providing sufficient cooling water to reduce the back pressure in the condenser to not over 2 in. of mercury. A secondary point on the head capacity curve of at least 74,000 gpm is also specified to provide a back pressure of not over 3 in. of mercury at maximum river-water temperatures of 85 deg with only one pump operating. Thus two pumps are normally in service, but in case of breakdown one pump will provide sufficient water to keep the generating unit operating at somewhat reduced efficiency.

With the cold water available last winter, and with two pumps in service per unit, the back pressures approached 0.5 in. of mercury. One pump could easily have furnished sufficient water to produce the 2-in. design limit established for summer conditions. However, the reduced back pressure produced far greater power in the turbine than was used by the 350-hp motor driving the pump. Both pumps are therefore operated continuously, and the flow is throttled at the condenser outlet for test purposes only.

Sluice gates 8 ft square are installed between each pair of condenser pumps. This in effect provides spare screen capacity, for one or both of these gates can be opened in case of

screen failure and water obtained from the adjacent pump pits. Water flow in both the supplying and supplied pits will have increased turbulence which will reduce the pump efficiency somewhat. However, this will be an emergency situation which should occur infrequently and will permit the continued operation of the main generating unit.

Each pair of pumps is connected to a 78-in. concrete pipe which conveys the water to a rectangular concrete conduit in the powerhouse substructure. At the condensers the water passages are split into two 54-in.-dia vertical pipes with 54-in. gate valves which direct the water to the divided water boxes of the condensers. At the discharge end of the condensers, piping similar to that on the inlet side conducts the water down to rectangular tunnels in the substructure and thence to discharge in the river. Butterfly valves are used on the outlet side to permit throttling the flow. Guide slots are provided at the outlets for slide gates so that the discharge conduits can be unwatered for inspection or repair.

Friction Losses Kept Low

Great care was taken in the design of all water passages in the condenser circulating water system to keep friction losses as low as economically feasible. As the total pumping head, including an 11-ft loss through the condenser, is only 20½ ft, the saving of 1 ft of head reduces circulating-system losses and pump horsepower requirements by 10 percent. Velocities throughout the system were maintained at approximately 7 fps except at the pump discharges and the reduced sections through the cone valves. All transitions were kept as smooth as possible; all bends were of long radius; and reducers and increasers at the valves followed the established basic design for Venturi meters.

The outlets to the harbor are in the form of increasers for a dual purpose — the reduction in velocity permits recovery of an appreciable part of the velocity head, and the reduced velocity has less effect on the mooring of coal barges which dock directly above the outlets. To compute the pumping heads, each system was divided into about 20 separate sections of pipe, valves, reducers, transitions, screens and condenser; and the losses at the design rates were determined as carefully as possible. The individual heads were totaled and rounded off to the next higher half-foot for use in pump specifications.

The motors are 4,000 volt, 350 hp, 266 rpm, vertical, solid shaft, totally enclosed, fan cooled, induction type with Kingsbury-type thrust bearings. Dripproof-type motors were considered but the greater reliability of the totally enclosed type was sufficient justification for the use of these more expensive units in this central station service. The controls for the pumps are located on the second floor of the water-treatment plant, which is adjacent to the pumping station. The operator in the control room overlooks the entire pumping-station deck.

Precautions Taken When a Pump Is Started

When a condenser circulating-water pump is started, precautions are necessary in order to keep hydraulic disturbances at a minimum throughout the system. The following sequence of operations was established for starting:

1. The condenser and all conduits are filled with water by auxiliary pumps and the vacuum system.
2. One pump is started at a time.
3. All valves are opened except those on the discharges of the pumps.
4. One pump is started and by electrical interlocks, the discharge valve starts to open at the same time. The discharge head immediately rises to shut-off and then as the valve opens and the long column of water starts moving, the head drops to about 10 ft, corresponding to a flow of 74,000 gpm.
5. The second pump is started and its discharge valve similarly opened. The discharge head rises to above the design point and then drops to a stabilized head of 20½ ft, or a flow of 112,000 gpm per pair of pumps.
6. The speed of opening the discharge valves can be adjusted within limits of 10 sec and 2 min. The opening time is made as long as possible in order to produce the least hydraulic disturbance in the system commensurate with pump motor overload.
7. When a pump is stopped, the above operations are performed in reverse except that the closing time of the valves is made as short as possible to prevent reversal of flow in the first pump stopped.

The specifications called for certified tests of the actual pumps or of identical pumps tested previously, or for computed curves based on model tests of hydraulically similar pumps. The pump manufacturer submitted curves derived from model tests, which were accepted.

Piezometer taps are available at several points throughout the circulating-water system where pressure drops can be obtained and the field capacity of the pumps determined. The section of the greatest drop is across the condenser water boxes. The loss of head in the clean condenser tubes is a reliable value established by the Heat Exchange Institute. The tubes are rolled into the tube sheets, forming rounded orifices with a coefficient of almost unity. Pressure taps are therefore provided on each water box, and are connected to a mercury U-tube or manometer. The deflections are noted and the corresponding flows obtained from the head-capacity curve of the condenser tubing. These are in turn checked against the head capacity curve of the pumps. These tests are made as soon as possible after starting up so that the condenser tubes will be clean and the pressure-drop readings reliable.

The tests made at Johnsonville showed slightly higher pump capacities than specified. Unit No. 1 has been operating practically continuously since October 27, 1951. Operating records show that the basic requirement of 2 in. of mercury with 79-deg water is exceeded by a small but comfortable margin. Tests of the turbines and condenser by thermodynamic principles also checked the satisfactory operation of the system.

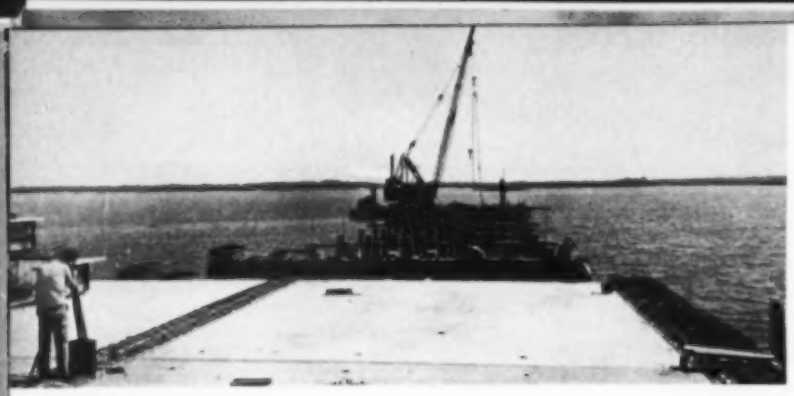
Congress on May 12, 1949, appropriated $54,000,000 for the construction of a 3-unit generating plant with a capability of 375,000 kw. Work started immediately. On March 28, 1950, Congress made funds available for a fourth unit and six months later appropriated additional funds for Units 5 and 6.

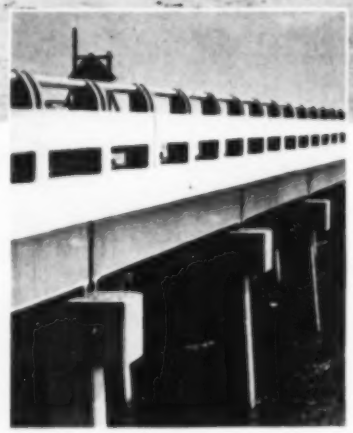
On October 23, 1951, steam was delivered to the turbine for the initial operation of Unit 1, which went on the line four days later. One month later the second unit went into commercial operation. The third, fourth, fifth, and sixth units were started on February 6, April 8, November 7, 1952, and February 18, 1953, respectively. The six units have a total capacity of 750,000 kw. It is estimated that the 6-unit plant as now authorized will cost not over $96,000,000.

The following manufacturers furnished the major pieces of equipment in the condenser water system: traveling screens, Chain Belt Co.; pumps, Ingersoll-Rand Co.; pump motors, Westinghouse Electric Corp.; cone valves, Chapman Valve Manufacturing Co.; concrete pipe, Lock Joint Pipe Co.; Butterfly valves, Henry Pratt Co.; and condensers, Ingersoll-Rand Co.

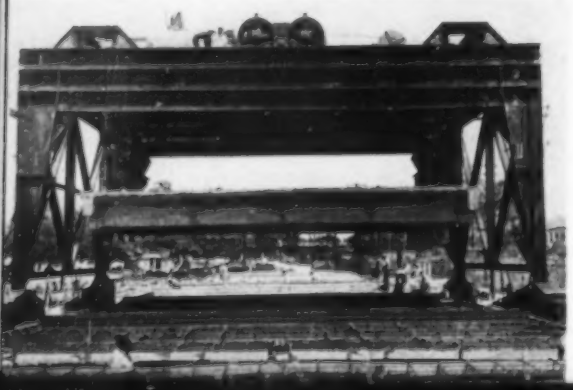
Production-line construction of

ROBERT H. WOOD, M. ASCE





Precast concrete piles were first driven (top view), then concrete caps were poured in place over each 8-pile group. Next precast deck slab for half roadway width was barged into position, and sidewalks, lower part of railing and 3-ft-wide median strip were poured in place (above). Inset at right shows aluminum railing and bent construction.



At contractor's yard on east shore of Bay of St. Louis, piles and slabs were precast. Prefabricated steel forms for 24-in.-square piles had removable points and adjustable headers and were placed on concrete slab in groups of nine (left). Fifty-two piles were cast per week for 43 weeks. For 119-ton deck slab units, ten casting floors were used to cast 8 half-span sections per week for 60 weeks. In bottom view, special gantry lifts deck slab from form. Holes in girder accommodate ties to keep form from spreading.

A bridge two miles long, formed of precast concrete units, is being completed June 30, 1953, to replace the antiquated timber trestle formerly used by traffic on U.S. Highway 90 to cross the Bay of St. Louis on the Gulf coast of Mississippi. In design this bridge is not unusual but the methods used for constructing it and for placing the large precast concrete units which make up the deck are of special interest.

The Bay of St. Louis, about 60 miles east of New Orleans and some 18 miles west of Gulfport, Miss., is an irregular body of water about six miles wide, extending inland from the Gulf of Mexico about the same distance. It is about two miles wide at its mouth, where it is crossed by the Louisville & Nashville RR and U.S. Highway 90, both on timber trestle structures. The water seldom exceeds 10 ft in depth at normal tide. The normal tidal range is 1.75 ft but hurricane tides may exceed 14 ft. Boat traffic consists of small fishing craft, pleasure boats, and a few light cargo vessels.

The timber-trestle traffic bridge, with a steel swing span for the navigable channel, has had to be rebuilt in part several times in the course of its 25-year life. It has been inadequate for traffic on U.S. Highway 90 for several years. Also it has become a fire hazard as parts of it have been completely destroyed by fire on several occasions, forcing traffic to go around the bay—a detour of more than 30 miles.

At its 1950 session, the Mississippi State Legislature passed a bill authorizing the State Highway Commission to acquire, construct, and operate toll structures across any tidewater, bayou or river tributary to the Gulf of Mexico or Mississippi Sound, and to issue bonds payable from the revenues derived from such projects. It was specified that maintenance and operating costs are to be borne by the State Highway Department and toll revenue is to be used exclusively to retire the bonds.

precasting and careful scheduling mark Bay St. Louis Bridge

Hazelet & Erdal, Consulting Engineers, Louisville, Ky.

As a result of an engineering survey, including borings, and a traffic study authorized by the State Highway Department early in 1950, it was ascertained that a high-type four-lane highway bridge across the Bay of St. Louis was feasible both from an engineering and an economic standpoint. In June 1950, the State Highway Department retained the firm of Hazelet & Erdal, consulting engineers of Louisville, Ky., to prepare plans for the bridge, designated Toll Project No. 1, and to supervise its construction. The construction estimates of $6,467,279 for the bridge and $425,000 for the approaches and miscellaneous work were found to be well within the apparent financial capabilities of the project.

In the meantime, the State Highway Commission had retained the firm of Coverdale & Colpitts of New York, N.Y., to make further independent traffic surveys and to prepare an economic report. This report, which was favorable, was submitted early in 1951. The basic toll charge used was 25 cents for passenger cars, with a graduated upward scale for various types of trucks and buses.

On July 19, 1951, Contract No. 1, covering the bridge from abutment to abutment with immediately adjacent shore protection, was awarded to Merritt-Chapman & Scott Corp. of New York for $6,061,433, which was $405,846 below the engineer's estimate. The specified date of completion was June 30, 1953.

The State Bond Commission received bids for $8,400,000 in revenue bonds on June 7, 1951. All bids were rejected and again received on June 14, 1951, at which time the proposal of the syndicate headed by A. C. Allyn and Co. of Chicago, calling for $3\frac{1}{2}$ percent interest, was accepted.

Contract No. 2, covering roadway and miscellaneous approach work, was let in July 1952 to Lacoste, Inc., of Gulfport, Miss., for $324,146.07, and Contracts 3 and 4, covering roadway paving, toll facilities and miscellaneous work, were awarded on the same date to Hyde Construction Co. of Jackson, Miss., for $336,924.25 and $133,262.20. All contracts are to be completed June 30, 1953, along with the initial bridge contract.

Beginning at a point on existing U.S. Route 90, just west of the City of Bay St. Louis, the alignment passes through the sparsely developed northern parts of the city and reaches the bay shore about 2,000 ft north of the existing bridge. The bay crossing is on a single tangent and reaches the Henderson Point (east) shore some 1,500 ft north of the present bridge. The center line then curves sharply to the south to intersect the present four-lane construction just north of the overpass crossing the Louisville & Nashville RR. The Henderson Point alignment is so located as to accommodate plans for the future relocation of U.S. Highway 90 to the east. The total project length is 3.73 miles, with 1.8 miles of roadway and 1.93 miles of bridge.

Two Lanes in Each Direction

In general, the design of the project is governed by the interregional standards for highway and bridge construction. Structures are designed for H20-S16 loading, under the current specifications of the Mississippi State Highway Department and the American Association of State Highway Officials.

Divided roadway construction, with two 12-ft traffic lanes in each direction, will prevail from end to end. The normal median strip is 24 ft wide to facilitate turning movements and reduce traffic hazards to a minimum. The width of this strip is reduced to 3 ft for the bay bridge and there are no crossovers between abutments. The bridge median strip is mountable in emergencies.

Service drives are provided in those areas where business establishments now exist or may be reasonably expected to exist in the future. At major intersections, where appreciable turning movements may be expected, left-turn safety lanes are provided by reducing the width of the median strip to 12 ft adjacent to the intersection. The intersection at Front Street in Bay St. Louis will be further controlled by traffic-actuated lights.

On the Henderson Point shore, a few hundred feet from the end of the bridge, is located the toll plaza and administration building. Toll registering equipment is of the latest design, with automatic treadle counters, tape recorders and similar safeguards.

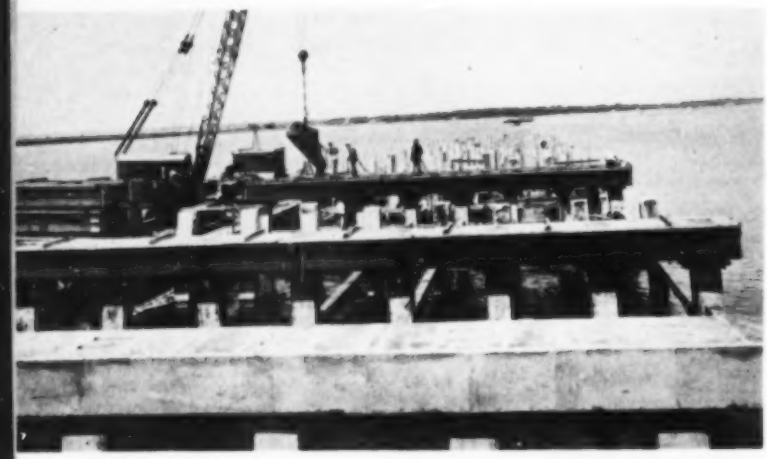
The bridge proper, from shore line to shore line, is 10,198 ft long. The western approach consists of 137 reinforced concrete spans, each 41 ft long, supported on concrete pile bents while the east approach consists of 104 similar spans. The bascule span and its steel side spans total 317 ft in length. The typical cross section has two 26-ft roadways separated by a 3-ft split median strip, and there is a 3-ft sidewalk on each side.

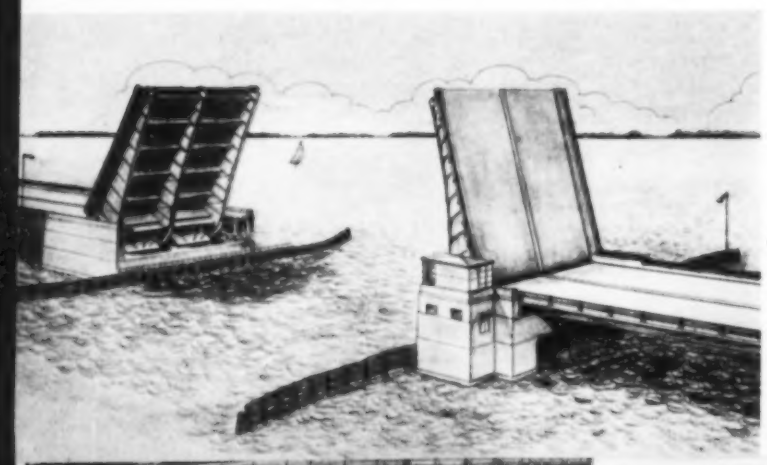
The question of using fill construction in the shallow water adjacent to each shore, particularly the sheltered section adjacent to Henderson Point, on the east side of the bay, was the subject of considerable investigation in the early stages of the design. Fill construction was finally discarded in favor of the typical bridge section to avoid beach property damage, the high initial cost of a stable fill, and continuing maintenance costs.

It is obvious that the greater part of the cost is for the 9,881 lin ft of trestle approach structure, and numerous alternates were considered before the final design was selected. These alternates included longer spans on piers and various combinations of spans and pile bents using several different sizes of piles. Required lengths as indicated from borings, the need for a pile of considerable flexural strength, the added cover required by exposure to salt water, and experience on similar projects in the coastal area, led to the selection of the 24-in.-square precast concrete pile. This pile, driven to

In photo (1) two hammers are driving last group of steel H-piles for mud pocket 900 ft long, found on east approach. These piles, up to 180 ft long, were encased in concrete from well below the mud line. All other piles in bridge are precast concrete. As shown in photo (2), concrete caps for all pile bents were cast in place, using metal forms. In photo (3), precast concrete deck section on barge is being maneuvered toward west approach trestle. Note sidewalk reinforcing along side of this section and of previously placed sections. Barge is maneuvered into position between bents so that deck section is immediately over screw jacks on bents. Barge is then lowered by pumping in water so that it can be floated out. Placing of each 119-ton deck section, including 3-mile average round trip on barge, was accomplished in $1^1/_2$ hours.

Navigation channel is spanned by double-leaf bascule seen in sketch (4), giving clear waterway width of 100 ft. Piers for draw span were constructed in open cofferdams with steel sheeting, which is to be left permanently in place. Bay St. Louis Bridge will be opened to traffic July 1, 1953.





60-ton capacity in bents of eight with a concrete cap, coupled with a simple reinforced concrete span of 41 ft between bents, appeared to offer the best and most economical solution and was therefore adopted. Spans were detailed so as to permit either cast-in-place or precast construction, with neither method prescribed or excluded.

A prestressed design was given serious consideration but in the final analysis was not favorably recommended by either the state's engineers or the consultants for this particular project.

The bridge railing consists of a lower rail of reinforced concrete supporting an upper rail of $3^1/_2$-in. aluminum pipe mounted on cast aluminum brackets. The pipe rail is 61S-T6 alloy, and the castings are 356-T6 alloy. The aluminum will not be painted, but the contact surface between concrete and aluminum is sealed with an aluminum pigmented bituminous paint to prevent reaction between the two materials.

The entire structure is lighted to an intensity of 0.8 ft-candle by the use of 16,000-lumen mercury vapor lamps mounted on aluminum standards and set 27 ft 6 in. above the roadway surface. Pole top ballasts are provided for each unit and the entire installation is automatically controlled by photo-electric relays.

War Department permits prescribed that the draw span provide a clear horizontal opening of 100 ft and a clear vertical opening of 80 ft. After investigation of several alternates, a three-girder Scherzer-type double-leaf bascule span was selected. Each leaf is operated by a 40-hp motor, and the normal opening time is 1 minute. A gasoline-engine generator set provides auxiliary power for emergency operation of the draw span and essential lights, gates and warning devices. However, the auxiliary motors are only 15 hp and the opening time under emergency conditions is increased to 4 minutes.

Aside from a few interesting details, the design features of this bridge offer very little that is new or out of the ordinary. The design should rather be described as a studied and careful application of well known and accepted types of construction molded to fit this particular site and the conditions existing here.

Construction Not Commonplace

In so far as the precasting and erecting procedures developed for the bridge are concerned, and the special equipment designed to implement these procedures, and more particularly for the 241 reinforced concrete girder spans, there is very little that can be called commonplace. It is true that precasting is not new, and bridges comparable to this one in size and importance have been very successfully erected using precast deck sections. But it is believed that many features of this project are unique and worthy of particular attention, including the extensive and detailed preparations made by the contractor prior to the beginning of actual construction, the development of production-line techniques in precasting, the thoroughness with which a 20-month construction schedule has been programed, and the speed and efficiency with which actual construction has been carried out despite extended periods of bad weather, unexpected foundation conditions changing the design of part of the bridge, and similar delaying factors.

The site chosen for the casting yard lies just north of the Louisville & Nashville RR tracks on the Henderson Point shore of the bay, and occupies some 5 acres. Originally a marsh, the area was filled in to about El. +6 ft using a hydraulic dredge. The site is easily accessible by rail, water and highway, but has one definite drawback in that all water traffic to it must pass through the existing highway draw-span.

The concrete mixing plant for the project was designed and located to fit the precasting plan of the contractor. A 79-cu yd, four-compartment aggregate bin atop the tower, and a 450-bbl cement bin, feed through automatic weighing devices to a Worthington dual-drum mixer, which discharged the concrete into 2-cu yd buckets which in turn were handled by a whirley gantry crane. The cement factor was 1.65 bbl per cu yd, and the water content ran about 4.85 gal per sack of cement. Mixing time was $1\frac{1}{2}$ min.

A complete concrete field laboratory, including cyclinder testing machine, was set up nearby by the engineers to design and control the mix, check the yield and air content, and otherwise insure rigid control of all concrete produced. Air entraining cement (Type II A) has been used throughout.

Prefabricated steel pile forms with removable points and adjustable headers were placed on concrete slabs in groups of 9, with spaces between piles exactly equal to the typical pile width. Previously assembled reinforcing-steel cages were set in place in the forms. Jet pipes of 2-in. diameter were initially cast in the piles for use in conjunction with outside jets but were later discarded.

The piles were then poured, the concrete vibrated and the top surfaces screened and finished off with a metal template. The vertical forms were collapsed in 24 hours and the sides of the newly cast piles coated with a wax-base membrane or kraft paper as a bond break, thus providing, when the point forms and headers were shifted, another complete set of forms into which 8 additional piles were immediately cast. The collapsed steel forms were moved to another location in the casting yard and set up for re-use. The pile casting schedule called for 52 piles per week for 43 weeks.

To minimize storage and rehandling and to maintain the production-line schedule, whenever possible piles were moved directly from the casting beds to the barges by a large gantry, and then to the bridge site. In each bent the four inside piles are vertical and the four outer piles are battered.

The 8 piles comprising a complete bent were set through a heavy timber template attached just above the water line to an accurately positioned and firmly anchored barge. The piles were then jetted and finally driven to their designated 60-ton bearing. A McKiernan-Terry S10 hammer was used with a specially designed boot. No leads were used.

In jetting, the 2-in center jet was augmented by two outside jets for directional control. The center jet was later eliminated after experience proved that the piles could be accurately and easily positioned by the two outside jets alone. All trestle piles are 24 in. square and vary in length from 41 to 100 ft, these lengths having been determined from 26 test piles. The driving schedule was the same as the casting schedule: 52 piles were driven per week for 43 weeks, and this sequence was 4 weeks behind the casting sequence.

It might be pointed out that the pile lengths determined by the test piles overran the original estimate based on the borings by a considerable amount. This was mainly because local soft spots were found, and indicates the danger of placing too much credence on isolated borings for this type of construction.

Deep Muck Pocket Encountered

Original deep borings taken before the contract was let were 1,000 ft and more apart, and failed to disclose a very unusual foundation condition on the east approach. Test piles driven in this area developed ample bearing with 5 to 8 ft of penetration into the sand below the muck layer which covers most of the bay, but immediately thereafter began to lose bearing suddenly, and in some cases dropped 20 to 40 ft by their own weight alone. After extensive investigations using long piles (both concrete piles and steel H-sections) as probes and auxiliary borings, the extent and nature of the unexpected situation were determined.

Beginning just east of Bent 142 and extending to just west of Bent 165, a distance of approximately 900 ft, there is a deep pocket of unstable material bridged over by a strata of firm sand 10 to 20 ft thick at about El. −40. This pocket drops to El. −120 at the deepest point at Bent 149, and below its bottom firm sand of indefinite depth was encountered. After considerable investigation and analysis of various schemes, it was decided to use 14-in. steel H-piles in this area, driven through the firm crust and penetrating about 20 ft into the very firm material below the pocket. These piles vary in length from 100 to 180 ft.

Laboratory tests of the firm material below the pocket indicated that the H-section would develop the necessary bearing, and test piles verified this prediction. The upper stratum of firm material provides some lateral support but, until the pile "freezes up" after driving, is of no value vertically. From a point well below the mud line, these 14-in. H 73-lb piles were encased in concrete to form a 24-in.-square composite section to protect the steel core and also to preserve the uniformity of appearance of the structure above the water. The contractor elected to precast the concrete encasement around the upper section of the 14-in. steel H-pile in the yard using his regular metal forms and leaving about 5 ft of the steel pile exposed for splicing. This encased section was welded to the previously driven lower steel sections in place and the entire composite pile driven the last 30 ft or so.

Considerable care was necessary to

prevent separation of the encasement and steel core during this driving, but it was accomplished with no evidence of slipping or damage. Special anchorage was provided by reinforcing bars extending through the steel web, and a special 2-ft wooden cushion head was placed in the top of the driving boot to insure that the hammer would act uniformly on both the concrete and the steel core. Jets were also used, which in some cases operated 140 ft below the surface.

This procedure permitted the precasting of deck sections in this area to continue as originally planned and has caused no appreciable delay in the completion of the project. The only change made in the superstructure as a result of this development was to fix both ends of spans supported on 8-pile bents and carry all deck expansion to 16-pile tower bents, which are placed 164 ft, or four spans, apart. It is assumed that the long, relatively limber steel H-sections will permit the slight longitudinal movement which will take place between the tower bents.

The added cost of the project occasioned by this rather extensive pocket was approximately $400,000 and this, with a general overrun in concrete piling and other miscellaneous extras, has increased the contract cost to about $6,600,000. It points up rather forceably the dangers of proceeding with a project of this type without very complete foundation studies. In this case the original deep borings were thought to be adequate, particularly with the added data available from pile records of both highway and railroad bridges paralleling and near the proposed line. It was unfortunate that two deep borings just 1,000 ft apart straddled the pocket perfectly, as if by design, and that the timber piles redriven in the highway bridge nearby in recent years gave no indication of such a pocket.

Next in sequence of operations came the casting of the concrete caps for the pile bents. This operation was performed in place using metal forms. It followed the driving sequence by 2 weeks, and proceeded at the rate of 4 caps per week. The only item of interest here was the forming of 8 recesses in the top of the cap to receive the masonry plate and its anchorage which would later be placed and grouted as a part of the span setting process.

In another part of the casting yard, the contractor had been preparing ten floors for slab casting operations. Prefabricated collapsible metal forms for a typical half span were placed on each floor, then reinforcing steel, cast shoes, and deck drains set in place, and the entire unit poured in one continuous operation. The pour amounted to 58.3 cu yd, and when lifted weighed approximately 119 tons. It should be noted that the typical intermediate bridge span is symmetrical about the center line of the roadway, so that all half spans are identical.

To insure absolute bearing when the span is finally set, the three parts of the expansion shoe (sole plate, rocker, and masonry plate) were temporarily tied together by four bars welded to the two plates. The two parts of the fixed shoe were similarly welded together, and both units anchored into the span by the sole-plate anchorage as the concrete sets.

Gantry Places Slab on Barge

When the slab had set sufficiently, the metal forms were collapsed, the lifting rods inserted into previously formed holes through each beam at the ends and adjusted, and the entire unit lifted by a gantry using two strongbacks, each supporting four lifting rods. It should be noted that the strongbacks were so designed that deflection due to the slab weight was negligible. The specially designed lifting gantry was operated by both steam and air.

The gantry moved the half-span deck slab into position over a specially designed barge anchored in a slip at the end of the gantry track, and lowered it crosswise onto adjustable cribbing on the barge deck. The height of the cribbing was determined by the height above water line of the bents to receive the particular deck slab being moved.

The barge was 35 ft wide by 100 ft long and had several separate compartments which could be filled with water or exhausted singly or in any desired combination so as to raise, lower or tilt the barge. This was accomplished by a single pump with connections to each of the compartments and centralized controls.

The barge supporting the span sections was towed into position between two designated bents and maneuvered until the span was directly above its proper position. Water was then pumped into the compartments and the span gradually lowered onto 12 hydraulic jacks set 6 on each bent cap. The barge dropped away and was removed, and the final adjustment of the span was accomplished by the jacks. The shoes were grouted into the recesses in the caps, and when they had set, the jacks were removed and the temporary tie plates holding top and bottom elements of the bearing assemblies together were cut away.

Barging a deck section from the casting yard and setting it in place had been worked out so smoothly that the whole operation, including the three-mile (average) round trip, could be accomplished in an hour and a half. This sequence followed the placing of the bent caps by 2 weeks. The schedule called for the casting and placing of 8 half-span sections (4 spans) per week for 60 weeks.

The remaining construction is conventional, the sidewalk, median strip and railing sections being cast in place, as are the two end spans. All four main piers have been constructed in open cofferdams, with steel sheeting to remain permanently in place. Erection of structural steel and machinery by the subcontractor, Nashville Bridge Co., began April 1 and is to be completed early in June 1953. Electrical work by the Power Electric Co. proceeded concurrently with machinery installation. Because of the long run to either shore, a 2,300-v main power feeder was run from the east bank to Pier 3 and a 100-kva, 2,400/240/480, 3-phase transformer installed there.

With today's high cost of construction a matter of concern and interest to all, a few cost statistics on the Bay St. Louis Bridge may be worthy of note. The 24-in.-square concrete piles were driven in place for $8.25 per lin ft; cap and deck concrete was placed for $67.20 per cu yd; and the unit price for reinforcing steel was 10 cents per lb, and for bridge railing $10 per lin ft. The all-inclusive construction cost per square foot of bridge deck for the typical approach trestle, excluding the main piers and bascule and side spans, averaged $8.12. The corresponding figure per square foot of roadway surface was $9.84, and the cost per lineal foot of trestle was $511.92.

With virtually all overages now determined, Contract 1 totals approximately $6,600,000, the increase being principally due to the change in design for foundation piling for that part of the east approach over the muck pocket previously described. This factor increases the bridge deck cost mentioned above to $8.89 per sq ft, with a proportionate increase in the other values. The project construction cost for the four contracts, plus certain work by state forces, is now estimated at $7,380,000, which is $488,000 or 7.1 percent over the preliminary estimate of $6,892,000. This will necessitate additional bonds totaling about $740,000.

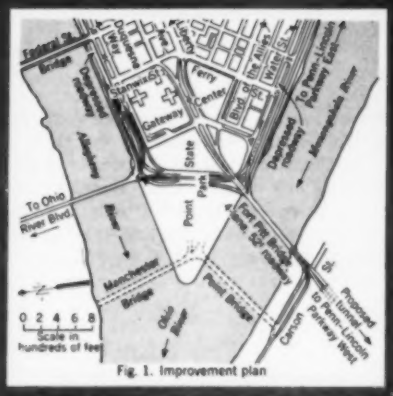


Fig. 1. Improvement plan

Pittsburgh's plans for the "Point," where Monongahela and Allegheny meet to form Ohio, include two double-deck bridges with complicated traffic interchange, Gateway Center building development, and park. Only the three buildings indicated in Fig. 1 have been constructed in Gateway Center.

Pittsburgh plans new bridges and traffic interchange at Point Park

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The tip of land between the Monongahela and the Allegheny Rivers at the beginning of the Ohio is known to Pittsburghers as the "Point." From early colonial days this has been a strategic location. Today the Point is the site of an outstanding development program that has attracted nationwide attention. The Point Development Project includes a Point State Park, planned as a memorial commemorating the historic importance of the site; an urban redevelopment project, the Gateway Center; and proposed new highway connections, which include two new bridges spanning the Monongahela and Allegheny Rivers and an interchange located within the park area.

The highway phase of the program is part of a system of expressways under construction by the Pennsylvania Department of Highways designed to relieve the intolerable congestion on the main thoroughfares and highways of the Pittsburgh and Allegheny County area. This locality has all the normal traffic problems of every metropolitan area, but aggravated by a topography which forces unusually heavy volumes through a few natural throats. The principal traffic routes follow naturally along the river and other valleys of the area, as will be evident by an inspection of Figs. 1 and 2. These routes converge at certain critical spots, of which the Point is one—actually the primary focal point of all traffic in the area.

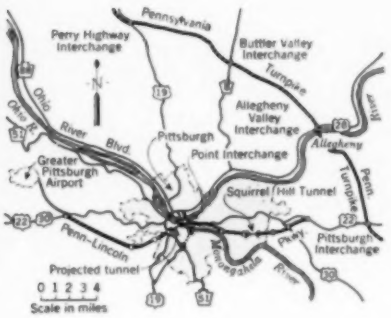
To relieve congestion in the central area of Pittsburgh, efforts have been made to encourage the use of a system of belt routes which form roughly concentric circles around the Point. The belt routes, however, are circuitous, and the general pattern of crossing ridges and valleys results in deficiencies in alignment and grade which are not conducive to a smooth traffic flow. Accordingly the very large natural flow lines are along the valleys, and many of the major ones pass through the heart of the business area located in the triangle just above the Point.

Vast Program Initiated

A vast program of highway improvements is needed. Funds for the expressway system come primarily from Pennsylvania motor funds with Federal Aid Urban participation. Although the funds are large in comparison with those available for many urban areas, they are very limited in comparison with real needs. As a result, construction of the expressway system has been confined up to this time to the Penn-Lincoln Parkway project. This is so named because when completed it will carry William Penn Highway (U.S. Route 22) and Lincoln Highway (U.S. Route 30) traffic through the area. These are the two main east-west routes through Pittsburgh. The eastern terminus of the project is on U.S. Route 22 about $9\frac{1}{2}$ miles from the central business district. This part is known as the Penn-Lincoln East, and construction (see an accompanying photograph) is substantially completed to within about two miles of the downtown area. The Penn-Lincoln West will begin at the Point and extend about 15 miles to the west. Construction on the Point area has not been started but a substantial part of the western extension beyond the Point area is nearing completion. One purpose, then, of the Point project is to provide the connecting link between the eastern and western extensions of the Penn-Lincoln Parkway. Reference to the plan of the project, Fig. 1, will show how it fits into this pattern and other requirements.

Fairchild Aerial Surveys, Inc.

Before start of work on plan for integrated traffic facilities and park at Pittsburgh's "Point," this area was maze of railroad freight facilities and ugly buildings served by inadequate and poorly located bridges. Railroad bridge second from Point on left has already been demolished, along with numerous buildings.



Two bridges were constructed over the Allegheny and Monongahela Rivers at the Point in 1874 and 1876, respectively. Both have been replaced by later structures, the former in 1914 and the latter in 1926. The later bridges were built at a location a little further upstream than the original ones, but still with the bridgeheads so near to each other that it is not possible to develop any satisfactory plan for separating conflicting traffic movements. The bridges for the new interchange will be located several hundred feet upstream from the point to overcome this difficulty. The Fort Pitt Bridge over the Monongahela will carry Penn-Lincoln traffic and local traffic with origins and destinations in the large residential and industrial area to the south and west of the business district. The Fort Duquesne Bridge over the Allegheny will be the principal connection to the Ohio River Boulevard (Route 88) and to areas north of the business district. Traffic estimates indicate that approximately 100,000 vehicles will flow daily through the interchange connecting the two structures only a few years after completion of the project.

The final plan adopted by the Pennsylvania Department of Highways, and approved by the Bureau of Public Roads, provides for an unusually direct flow and complete separation of all traffic passing through the interchange. Both bridges will be double deck. The Fort Pitt Bridge over the Monongahela will carry four lanes of inbound traffic on the upper deck and four lanes of outbound traffic on the lower deck. On the Fort Duquesne Bridge, which will have three lanes on each deck, these traffic directions will be reversed, outbound traffic using the upper deck and inbound the lower deck. All traffic movements will proceed along the traffic paths which would normally be used at grade. With the double-deck scheme this simple arrangement is possible, and at the same time all conflicting traffic movements are separated.

Traffic Relief Promised

The project will greatly relieve the traffic load on the street system of the business triangle. At present more than 50 percent of the traffic using this street system is destined for points outside the central area. There are short sections for express routes on both the Monongahela and Allegheny River sides of the triangle; however, they function very inefficiently because of lack of connections.

In the program as now planned, the express route along the Monongahela will be part of the Penn-Lincoln Parkway, and that along the Allegheny will be connected directly to the new interchange and both the new bridges. By means of these two routes more than 50 percent of the traffic entering the interchange over the two new spans will bypass the business district. Also, traffic movements into and out of the business district will be greatly facilitated by the numerous points of entry and exit available along the waterfront routes and the direct connections provided in the interchange to and from Liberty Avenue and the Boulevard of the Allies.

There is a tendency in discussing projects of this kind, particularly those financed through a state highway department, to consider them in relation to the principal highway routes. Actually in large urban areas such as Pittsburgh, the long-distance through traffic using such facilities is a small percentage of the total traffic volume. The main function of such projects is to relieve the congestion resulting from local traffic requirements, and particularly that of the morning and afternoon peak hours.

Bridge Design Studied

There will be difficult problems to solve in the construction of the Point highway project. There is a tremendous volume of traffic on the rivers, particularly on the Monongahela. Navigation requirements therefore play a large part in controlling the layout of the river spans. To meet these requirements on the Monongahela crossing requires a main river span of about 750 ft. Normally a span of this length can be constructed to the best advantage as part of some multiple-span system, and if this were possible a number of types of structure might be considered. On this project, however, the necessary arrangement of the connecting ramps to the Point Interchange prevents the use of any mul-

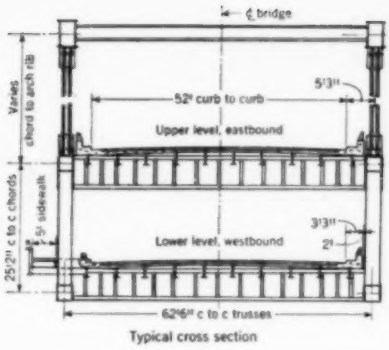


FIG. 3. Present plans for Fort Pitt Bridge over Monongahela River, located as shown in Fig. 1, call for double-deck structure with four lanes on each deck.

Construction along Monongahela River, looking toward the "Point," will lengthen wall of abandoned lock and fill behind it to provide room for new Second Avenue and for Penn-Lincoln Parkway East. Sheetpiles were driven along river side and water pumped out of working area. Photo by Blaw-Knox.

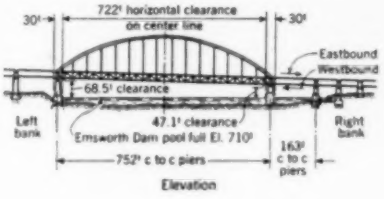


FIG. 2. Main highway routes through Allegheny County and Pittsburgh, Pa., will be integrated and connected by new traffic facilities now under construction at tip of Golden Triangle.

tiple-span structure. This will be realized by reference to the general plan, Fig. 1.

As a result, the choice of structure is narrowed to two possibilities—a simple span or some form of tied arch. The former would be near the limit for simple span construction, and awkward architecturally. In considering the types of tied arch, it was decided to take advantage of the double-deck floor system by introducing a truss with a depth approximately that available between the upper and the lower floors, using it as both a stiffening member and a tie for the arch. This will permit the use of a plate girder for the arch rib with a very shallow depth for a span of this length.

The companion structure over the Allegheny River will be built with a main span of similar design, although of shorter length. Navigation requirements there will be satisfied by a span of about 450 ft from center to center of piers.

The double-deck arrangement of ramps leading to and from the bridgeheads, although very advantageous in the solution of traffic problems, involves difficult framing problems to tax the ingenuity of structural designers. This is particularly true in maintaining clean and orderly arrangements which will also be satisfactory architecturally.

Foundation problems are not unusual. A sound bed of ledge rock is available approximately 50 ft below the normal pool elevation of the rivers, to which the main piers will be carried. In the Point area, beds of sand and gravel permit the use of spread footings or pile foundations for the approach spans.

Construction Program

The wide distance that separates the new bridges from the present ones will permit maintenance of traffic via the latter until the new ones are completed, but construction of the interchange and of the Carson Street connections on the south side of the Monongahela will require a carefully planned construction program to avoid the total disruption of vehicular and streetcar traffic through the Point area. After completion of the bridges, the streetcars now using the Point Bridge will be abandoned, and buses or trolleybuses will be substituted.

It is not possible at this time to determine a construction schedule for the whole project. It is anticipated that the first contract, including the substructure work for the main span of the Fort Pitt Bridge over the Monongahela River and some of the piers for the approach spans, will be awarded early this summer. It is hoped that the entire project may be completed within four or five years, but progress to a very large extent will be determined by the funds available for construction. Among other things, the connection to the Penn-Lincoln Parkway West will include twin tunnels under Duquesne Heights for a direct connection to the Saw Mill Run Interchange. With the new bridge and these tunnels, the distance from the Point Interchange to the Saw Mill Run Interchange will be about 6,000 ft. An alternate route along Carson Street and a new bypass through the West End, recently completed by the Department of Highways, is more than twice this distance, and leads traffic through a heavy transfer point on the mass transportation system and an interchange at the south end of the West End Bridge over the Ohio River, which is at present overtaxed at peak-hour periods.

The possibility of financing the tunnel construction by a toll authority is being explored, and may be authorized by the State Legislature. If this is not done, and if the funds available to the Highway Department from other sources are not greatly increased, construction of the tunnels will not be possible for ten or fifteen years.

A great number of engineers in the Pennsylvania Department of Highways have had a part in the development of plans for this project. At present the program is proceeding under the following principal engineers: E. L. Schmidt, formerly Chief Engineer of the Department and now Secretary of Highways; C. H. Buckius, M. ASCE, Chief Engineer; E. T. Baker, Chief Design Engineer; Leo A. Porter, Bridge Engineer; and L. J. Curran, District Engineer for the Pittsburgh area. The writer has been consultant to the Department in the development of the preliminary plans and for the design and preparation of construction drawings.

Prestressed concrete frames characterize U.S. Army

An outstanding feature of the Heidelberg Post Quartermaster Center at Mannheim-Friedrichsfeld, Germany, is the laundry and dry-cleaning building. This structure, 124 × 442 ft overall, with a clear span of 100 ft in the main hall, has a skeleton consisting of 21 prestressed reinforced concrete frames, spaced at 20 ft.

The new Heidelberg Post Quartermaster Center is typical of the extensive construction program under way in the European Command to augment and adapt former German Army facilities to the needs of the U. S. Army in Germany. The project, started early in 1952 and completed in the fall of the same year, provides modern centralized facilities for laundry, dry cleaning, repair and maintenance of Quartermaster equipment, as well as warehouse and office space.

The laundry building, here described, has walls of cinder block, a floor of concrete slab, and no basement. Prestressed prefabricated concrete slabs are used for the roof, with a 1-in. coating of light-weight concrete for insulation, topped with a double layer of roofing paper. Large skylights are provided for maximum utilization of natural light.

Freyssinet Prestressing System Used

Design and execution of the prestressed frames were handled by the German firm of Wayss & Freytag, Mannheim, using Freyssinet patents. In each frame there are 8 cables, each consisting of 12 wires of 5-mm diameter. Prestressing of the head beam and of the legs of the frame was carried out separately, the cable systems crossing at the knee of the frame.

The cables, sheathed in light-metal tubes, were placed in the forms before the concrete was poured. When the concrete had attained sufficient compression strength (after about 6 or 7 days), the cables were stressed, two at a time, using double-action hydraulic jacks. With the ends of the wires wedged securely into the head of the jack, the head was forced outward, away from the concrete. The cables were stressed to 10,000 kg per cm² (142,000 psi) after which, by means of a piston in the nose of the jack, a concrete cone was forced into the concrete socket through which the wires run. The wires were thus wedged in such a way that the stress was maintained by friction between cone and socket.

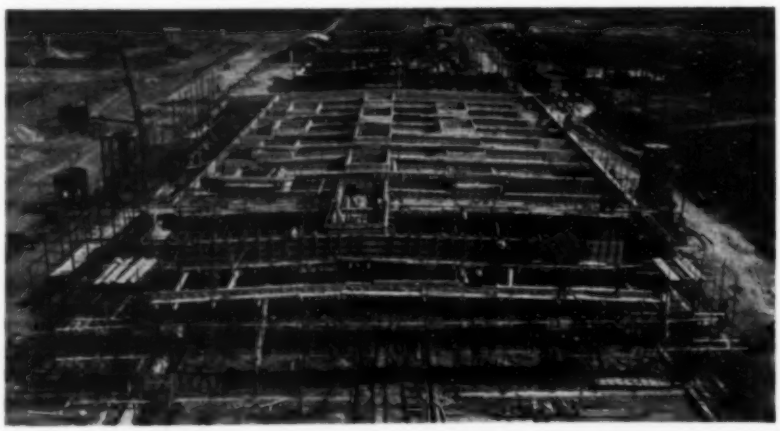
After removal of the jack, the cables were secured against slippage by pumping grout through a tube in the center of the concrete cone. During the prestressing process, each wire was elongated approximately 7 in., or 0.6 percent. After the removal of the jack, slippage between cone and socket amounted to approximately 0.5 in.

Innovation in Laundry Equipment

The laundry and dry-cleaning plant was started in February 1952 and completed in December 1952. The equipment installed is the most modern in Europe, the largest supplier being the firm of Poensgen Bros., Düsseldorf, Germany. Other items came from England, Sweden, Holland and Denmark, as well as from other German firms and from the United States. An innovation in laundry equipment is the "Carousel," a ten-cell, revolving, reverse-flow washing machine, designed to do the work of three of the stationary washers formerly in use, with greater economy in manpower, water and soap. The design capacity of the entire plant is 200,800 lb of laundry and 19,200 lb of dry cleaning per 40-hour week—sufficient for 20,000 men.

Other buildings erected at the site are a warehouse, a central heating plant, a motor shop, and a combined office building and equipment repair shop. Final completion of all major facilities at the site was effected by March 1953.

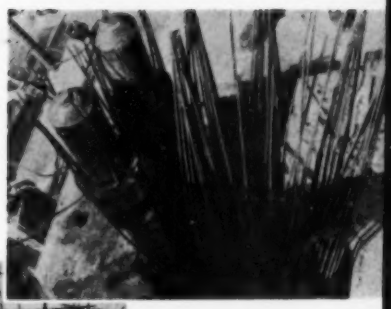
Architect for the project was the German firm of Gustav Geyer. Preliminary design and coordination was handled by Herbert J. Baker, of the post engineer construction staff. Overall supervision was by the Heidelberg Post Engineer office, headed by Col. L. E. Cox.

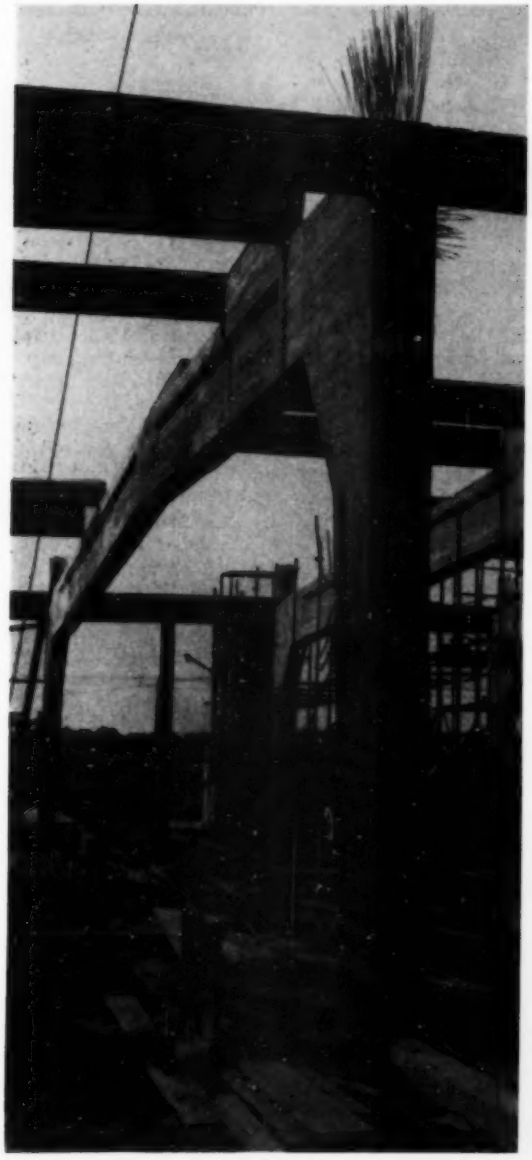


In laundry building, eleventh and twelfth frames were formed up on April 10, 1952, representing 50 percent completion of building's skeleton two months after start of construction. Boxes in roof are for skylights, to take full advantage of natural light.

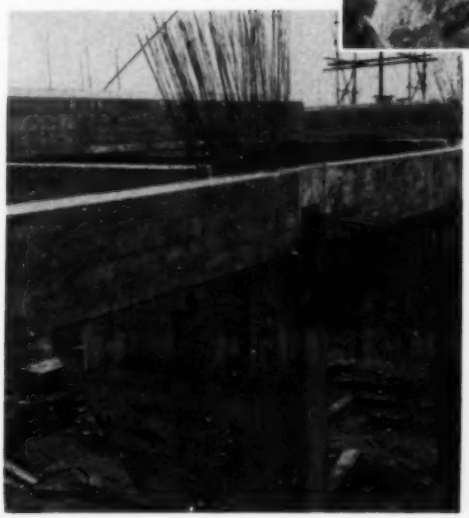
laundry in Germany

OTTO W. STEINHARDT, J. M. ASCE, Captain, Corps of Engineers, U.S. Army

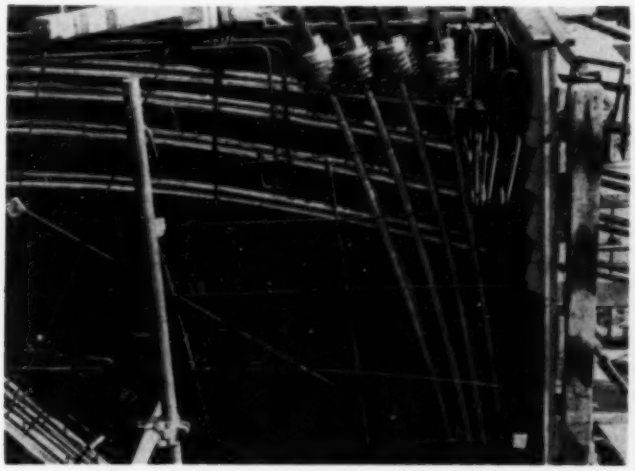




Frame is prestressed by eight cables in each direction, each cable consisting of twelve 5-mm wires. Here wires have been prestressed and grouted but not yet clipped off.



Close-up of corner of concrete frame (above) shows wires projecting after completion of prestressing and grouting. Head beam and legs were stressed separately, the reinforcing systems crossing in the corner of the frame, as shown in view below, taken before form was closed up. Cylindrical objects at top of cable sheaths are high-strength concrete sockets into which Freyssinet cones will be wedged during prestressing process. In view at upper corner of page, Freyssinet cones and jacks are in place for prestressing two of eight cables in leg of frames. Cables tied together at top have not yet been stressed.



Sewage disposal project cleans up

R. C. KENNEDY, M. ASCE, Chief Engineer, East Bay Municipal Utility District, Oakland, Calif.

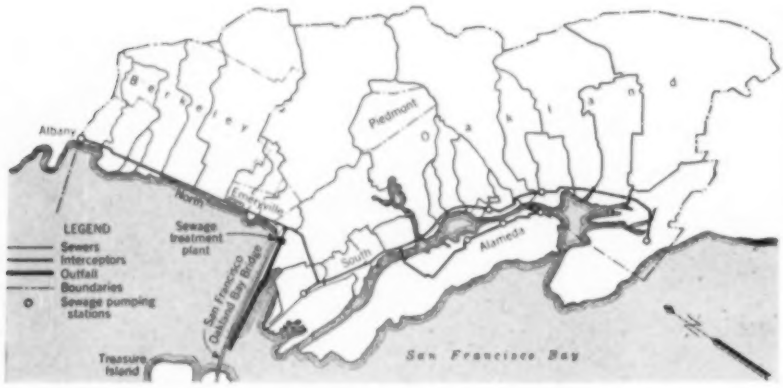
FIG. 1. Special District No. 1, comprising six municipalities in Alameda County, Calif., has built $23,500,000 sewage disposal project providing primary treatment. Previous odor conditions along the shore of San Francisco Bay will be eliminated.

For over a hundred years the ten cities spread along the east shore of San Francisco Bay discharged their raw sewage directly into the bay and its adjoining waters. This misuse of the beautiful harbor has long been a source of controversy and civic shame. Finally, during the past two decades, the sharp increase in population and industry have made the condition so intolerable that steps have been taken to solve the problem.

In July 1940, seven of the cities appointed a board of consulting engineers, consisting of Charles Gilman Hyde, A M Rawn and Harold F. Gray, all Members of ASCE, to "study and report on the collection, treatment, and disposal of sewage and industrial wastes of the East Bay cities." The resulting monumental report was completed in one year. Among the other recommendations, the board proposed that the East Bay Municipal Utility District, which was already organized and supplying water to these cities and to the surrounding territory, be given the additional responsibility of constructing and operating a multi-city sewage disposal project.

Studies Lead to Bond Issue

Shortage of men and materials during the war years prevented any progress on the sewage disposal problem other than the enactment of certain legislative changes required to permit a Municipal Utility District to undertake a non-revenue-producing function, and completion of the studies of sewage quantities and types to be expected. The organic act under which the District operates, as revised, provides that a special district may be formed within a Municipal Utility District, but prohibits inclusion of territory in more than one county in the district. As a result, only six cities are included in the sewage disposal project, namely, Oakland, Berkeley, Alameda, Albany,



Primary treatment only is provided. After chlorination and screening, five 42,000-gpm pumps lift sewage 35 ft to grit chambers. Ten sedimentation basins are followed by three digester tanks. Center photo shows main pumping plant building with grit chambers at left. Pumps are shown in photo below. Administration and laboratory building (far left) matches main pumping station.

San Francisco Bay

Emeryville and Piedmont, with a total area of 54,643 acres. Certain other areas, which because of the direction of their natural drainage, should have been included, could not be because of this legal limitation.

Studies of the District were guided by Samuel A. Greeley, M. ASCE, as consulting engineer. When these studies were completed, after the termination of the war, N. T. Veatch, M. ASCE, and the late Clyde C. Kennedy, M. ASCE, were also employed. These three consultants reviewed the studies and estimates and, in July 1946, rendered their report and recommendations to the Board of Directors of the District.

The estimated cost of the sewage disposal project was $22,456,000. To allow for interest during construction, this was increased to $23,500,000, for which amount a bond issue was voted in November 1946.

Sewage Quantities Determined

The six cities comprising Special District No. 1 (Albany, Berkeley, Emeryville, Piedmont, Oakland and Alameda) together with the sewer interceptors and outfalls are shown in Fig. 1. There are 32 principal sewer zones, and a number of minor ones, each having an outfall which has been intercepted. A serious difficulty lay in the fact that half of the zones were partially or wholly drained by combined sewers, their area totaling 19 percent of the ultimate sewered area of the District. Also, great numbers of roof leaders and other drains are connected illegally to the sanitary sewers. It would have been impracticable to build enough capacity into the interceptors and the treatment plant to handle both storm water and sanitary sewage. The cities, therefore, have largely made such alterations as are necessary to effect separation. In such separated areas, an allowance of 2,000 gal per acre per day was made in recognition of the difficulty of complete storm-water removal. In each case where combined sewers remain, interception is by means of a bypass structure which limits the intake to a predetermined amount, the mixed excess passing to the bay through the old outfall. In these cases, the maximum storm-water intake provided for is 0.02 in. per hour over the area drained.

Many of the existing sewers are very old and in bad condition, and many are below the groundwater level. These conditions made it necessary to allow for infiltration. The adopted rate was 2,000 gal per acre per day for areas whose sewers were built before 1930, and 500 gal per acre per day for the remainder. Since infiltration is expected to be much greater during the six-month rainy season than during the dry summer and fall, one-half of these rates were assumed to represent the annual average. In the City of Alameda, 1,000 gal per acre per day was allowed for throughout the year because of the porous soil conditions peculiar to that area.

The total storm-water allowance was 26.9 mgd, which is 10 percent of the ultimate plant capacity. The infiltration allowance was 68.11 mgd, or 25 percent of the plant capacity. This total of 35 percent represents a safety factor on the capacity allowance for interceptors and treatment plant, since if sanitary sewage should exceed the estimated quantity, the storm-water and infiltration intake can be correspondingly reduced at relatively small cost.

The amount of domestic sewage provided for was based on the estimated water consumption for each census tract, with an allowance for water used for irrigation. Similarly, studies were made of industrial water use in each census tract, and estimates were extended for future developments according to the adaptability of the various areas to different types of industry. All industrial water was assumed to reach the sewers. Table I gives the results of these studies in terms of the *average* sewage flows expected. Peak flows

TABLE I. Average Quantities of Sewage Expected

	1970	2000
Population	716,900	884,900
Domestic sewage, mgd	37.28	46.12
Industrial sewage, mgd	33.72	48.07
Total sewage, mgd	71.00	94.19
Gal per capita	99	106

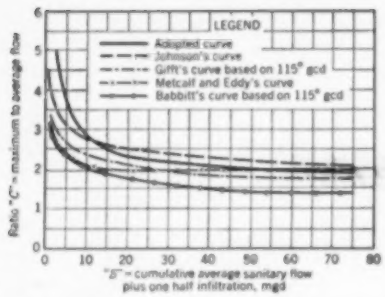

LEGEND
Adopted curve
Johnson's curve
Gifft's curve based on 115° gcd
Metcalf and Eddy's curve
Babbitt's curve based on 115° gcd
Ratio "C" = maximum to average flow
"S" = cumulative average sanitary flow plus one half infiltration, mgd

FIG. 2. Peak flows to be provided for were estimated by use of curve shown by heavy, solid line, adopted after study of recommendations of a number of authorities.

were estimated by use of the curve shown in Fig. 2, which was adopted after study of the recommendations of a number of authorities. It will be noted that the maximum factor used is 5 and the minimum about 2 and that half the infiltration is added to the sanitary flow to determine the average quantity. The effect is to allow capacity for up to $2^1/_2$ times the estimated infiltration in the upper portions of the interceptors, but this factor quickly decreases as the total quantity becomes larger.

Those facilities of the project which cannot readily be given increased capacity by the addition of units, were designed for the quantities estimated for the year 2000. These facilities include all interceptors, pumping plant buildings, and spillways. Other facilities were designed for 1970 needs.

Concrete Selected for Sewer

Early in the investigation of the project, efforts were made to develop a concrete which would withstand the chemical disintegration commonly experienced in sewage works, and which would have other desirable characteristics. From studies and tests carried out by Prof. Raymond E. Davis, M. ASCE, of the University of California, who was employed for this purpose, it was concluded that superior resistance to both sulphate and acid waters could be obtained through the use of concrete containing a mixture of portland cement low in tricalcium aluminate and a finely divided active puzzolan high in opaline silica, using the proportion of about 75 percent cement to 25 percent puzzolan. A commercial air-entraining agent added to the mix was found to substantially reduce drying shrinkage and permeability, and to give increased resistance to the action of sulphate and acid waters.

This experimental concrete showed a compressive strength generally less than that of plain concrete at early ages, but at 12 months its strength was definitely greater. This concrete has been used throughout the project for all pipe and structures which have contact with sewage, water, or earth. Since the puzzolan was used as a cement replacement, the cost of the ingredients was less than for plain concrete.

The general plan of the intercepting system is shown in Fig. 1. It totals some 21 miles in length, varying from 15-in. pipe to a 105-in. horseshoe section poured in place. At locations where the subgrade is soft, totaling about three miles, the line is supported on piling. The design of the interceptors with pile supports is shown in Fig. 3. The design without pile supports is similar except that the depth of Class B concrete under the sewer pipe is reduced from 15 in. to 6 in. Great care was taken to make all joints as perfect as possible, with the result that the total leakage proved to be only 47 gpm, in spite of the fact that all pipe is below the groundwater level, some as much as 25 ft.

All pipe was designed for a minimum velocity at average flows of 2 ft per sec. This resulted in slopes as low as 0.5 ft per 1,000 ft in some sections of the interceptors, but was considered satisfactory since special care was taken to establish rigid support for the pipe and thus prevent reversal of grades due to settlement.

Manholes are provided along the interceptors at angles, at connections with city outfalls, and at other locations, spaced at a general maximum of 1,000 ft. All are of concrete, with locking cast-iron covers. No ladders are built into the manholes, it being considered safer to utilize a portable extension ladder for access. Ledges just above the crown of the pipe are provided for lowering platform planking. Nine small pumping plants and one larger booster plant are built along the interceptors. Spillways equipped with tide gates are placed at strategic points for emergency discharge of sewage in case of power failure at the pumping plants.

Primary Treatment Only

The very large volume of San Francisco Bay, its swift tidal currents, and the high oxygen content of the water, make possible the economy of a primary treatment plant. At the main pumping station the flow is first chlorinated, then screened through 1-in. bar screens equipped with automatic mechanical rakes. Five 42,000-gpm pumps then lift the sewage 35 ft to the grit chambers. The discharge line from each pump is equipped with a 42-in. non-slam check valve to prevent back flow.

The grit chambers are of standard type, $12^1/_2$ ft wide, 10 ft deep and 60 ft long, with mechanical scrapers. Velocity is 1 fps; retention, 1 min.

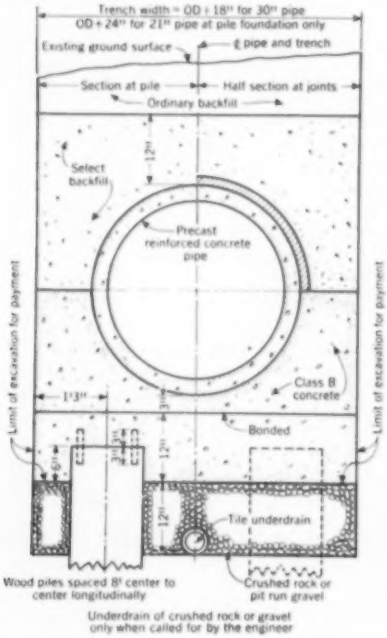

Trench width = OD + 18" for 30" pipe
OD + 24" for 21" pipe at pile foundation only
Existing ground surface
℄ pipe and trench
Section at pile
Half section at joints
Ordinary backfill
Select backfill
Precast reinforced concrete pipe
Class B concrete
Bonded
Limit of excavation for payment
Limit of excavation for payment
Tile underdrain
Wood piles spaced 8' center to center longitudinally
Crushed rock or pit run gravel
Underdrain of crushed rock or gravel only when called for by the engineer

FIG. 3. Design of interceptors with pile supports is indicated for both 21-in. and 30-in. precast reinforced concrete pipe. Where no piles are required, only 6 in. of Class B concrete, instead of 15 in., is provided between the pipe and the crushed rock.

RIGHT: For about three miles of its 21-mile length, interceptor is supported by piles (see Fig. 3). Here workmen place concrete slab over piling before laying reinforced concrete pipe sections of 7-ft inside diameter.

By hydraulic model studies, it was found that 30 ft could be saved in the channel lengths by introducing the flow in a non-turbulent condition. This was accomplished by gradually changing the section of the vertical risers from the pumps, from 42 in. round to 10 ft square. In the outlet from each square elbow, four horizontal deflector vanes are fixed, which effectively control vertical turbulence in the grit chambers. The grit is washed and buried with the screenings on the plant grounds.

The channel leading to the sedimentation basins is equipped with aerators to prevent settlement of solids at low flows. Rate of aeration is 0.15 cfm per sq ft of surface.

Ten bifurcated sedimentation basins are constructed for the 1970 requirements, with provision for two additional units for ultimate flows. Each basin is $33\frac{1}{2}$ ft wide (net), 13 ft deep and 172 ft long, giving capacity for 40-min retention for the maximum flow and about 2 hours for the average annual flow. It is expected that the recovery of suspended solids will be 50 percent. The clarified sewage is removed from the basins by means of steel troughs with V-notch weirs, the total weir length per basin being 592 ft.

Sludge and scum are pumped together into three digester tanks equipped with floating roofs. Gas generated from the sludge decomposition is used to warm the sludge, and the excess is at present burned. With the three present tanks, of 813,000-cu ft total capacity, the 1970 estimated maximum-month load of 90,315 lb per day will result in a load factor of 3.3 lb per month per cu ft. The digested sludge is discharged into the outfall sewer at times of favorable tidal flows.

Space has been provided at the 25-acre treatment plant site for additional facilities if and when needed, and the design is such that the minimum of alteration of the original structures will be required for such additions. Thus the plant can readily be made to include pre-aeration, complete treatment by the activated sludge process, dewatering of sludge by vacuum filters, and complete drying of sludge.

Following sedimentation, the sewage flow is carried through a 10-ft 9-in. × 11-ft 6-in. channel to the outfall pumping plant at the west end of the site. This plant is equipped with two 70,000-gpm variable-speed pumps, with provision for a third unit. The pumps automatically come into operation at times of peak flows or high tide. Beyond the pumps the outfall consists of 1.76 miles of pipe installed on land and 1.11 miles of submarine pipe.

Land section of outfall (above, left) consists of reinforced concrete pipe of Lock Joint type, 9-ft inside diameter, in sections 16 ft long, lead calked. For entire length, this section is supported on timber piling up to 110 ft long. On submarine section of outfall, sections are lowered by barge derrick (above, right). These sections have 8-ft inside diameter and length of 24 ft, with rubber-gasket slip joints. Sewage is carried about one mile offshore before discharge in 40 ft of water.

The land section of the outfall is reinforced concrete pipe of 9-ft inside diameter, lead-calked, Lock Joint type, manufactured in sections 16 ft long. For its full length the line is supported on timber piling, which at some points has 110-ft penetration. The pipe rests on a reinforced concrete platform supported by the piles, and the trench is backfilled with sand. Since the line alternates between being less than full under low flows, and being under pressure at high flows, air vents are spaced at intervals. These are 16-in. open pipes, extending 30 ft above top of sewer.

The submarine part of the outfall is made up of concrete pipe of 8-ft inside diameter, with rubber-gasket slip joints. The sections, 24 ft long, are held together with two heavy bolts, one at each end of the horizontal diameter, thus allowing for some adjustment in case of settlement of the line. A trench was excavated into the sand stratu n underlying the bay mud, and the pipe was assembled on wood blocks placed on this foundation. Because of the heavy load of silt carried by the tidal currents, the divers who assembled the pipe worked in complete darkness. The trench was backfilled up to 8 ft above the top of the pipe with sand dumped from barges. The rest of the trench depth was left to be filled by sedimentation.

The end of the outfall sewer lies 40 ft below low tide. Dispersion of the sewage is provided for by thirty-eight 16-in. horizontal outlets along the top of the pipe, spaced uniformly on 8-ft centers over a length of 294 ft. A heavy rock fill along each side of this part of the pipe prevents rolling or shifting under tidal currents which run as fast as $3\frac{1}{2}$ fps.

The operation and financing of the sewage disposal project are completely separate from the water supply activities of the District, this separation being particularly important because the area served by the project is only a part of that included in the parent organization. The principal income is derived from a general tax of 12 cents per $100 of assessed valuation, which supplies about 45 percent of the necessary income, and a charge based on water consumed, which supplies the remainder. Each residential unit is charged uniformly 35 cents per month based on estimated consumption, and all other users are charged 4 cents per 100 cu ft of water registered by their meters. In the case of the latter, adjustments are made if more than 20 percent of the water used is disposed of other than into the sanitary sewers.

The treatment plant went into initial operation in November 1951, with a gradually increasing load as the cities connected their outfalls to the interceptors. At present most of the area is connected, and tests show highly satisfactory results from treatment. In November 1952, 49 percent of the total solids and 96 percent of the settleable solids were removed from the sewage. There is no surface evidence of the sewage discharge at the end of the outfall. The previous odor condition along the bay shore has been practically eliminated, and will be entirely, it is expected, when the few remaining sewer outfalls are intercepted.

(This article was prepared from Mr. Kennedy's paper presented before a Sanitary Engineering Division session at the Society's San Francisco Convention. The session was presided over by Erman A. Pearson, chairman of the San Francisco Section's Sanitary Engineering Committee.)

A university president looks at

The American pattern of engineering education has long been admired for its ingenuity, imagination, and flexibility. I know of none better in the world. Yet there is continuing concern for its improvement, and these are days of great curricular change, including a strong shift toward something beyond the technical and the scientific, toward getting the engineering student down from the girders and onto the platform with Sophocles and Goethe.

A Broadened Curriculum

Unquestionably this concern and this trend are justified and will not be without results. Today one-third of the management of large industry in the United States is in the hands of engineers, and more than one-third of the mature graduates of engineering colleges find their duties chiefly managerial. In these circumstances, the responsibilities of the engineer as a citizen become increasingly significant, and his education in economics, in political science, and in the humanities can hardly be safely neglected any more than his education in stresses and strains, in vectors, and in the calculus of variations.

As Benjamin Fairless, M. ASCE, president of the U.S. Steel Corporation, said when he accepted the John Fritz Medal last year, the engineer must know his facts completely and exactly, and he must be governed by them absolutely. For if the design of his bridge is only 99 percent right, it is likely to be 100 percent wrong, and the bridge ends up "in the drink." However, Mr. Fairless, I am sure, would agree that there are many human and social areas in which equations and formulas do not apply, and where the design seems to most of us 99 percent wrong, but where the structure still stands. The trick is to know when to cast aside the logarithm tables and to pick up the writings of a Spencer or a Toynbee.

Speaking of Students and Professors

After this quick look at the curriculum, we come naturally to the students and the professors. Looking first at the engineering student, the carefully selected engineering student of today, as I see him on the campuses of the University of California, I am glad to report that he is generally well prepared for the courses he proposes to take. The scientifically devised entrance requirements—high but not too high—and the qualifying examinations designed to disclose aptitude as well as intellectual quality—not to keep the enrolment low but to give the competent an additional opportunity to qualify—combine to provide the colleges of engineering each year with promising raw material or a product well begun and capable of further refinement, eventual professional advancement, and ultimate success.

The sincere interest of the faculty in the students as individuals contributes heavily to this result. Ability to teach and to guide young people is still honored—and always will be—as the *sine qua non* for continuing appointment and advancement. In the University of California Colleges of Engineering, research is not stressed to the detriment of the student-teacher relationship. However, the volume and quality of research and its useful, practical applications are regarded with increasing pride and rewarded materially as well as spiritually. And rightly so, for he who teaches without research, especially in a field as dynamic as engineering, too often becomes a salesman of second-hand goods, the bare threads of which may be a lasting part of the traditional garb of education but otherwise have little to commend them.

That the Colleges of Engineering of the University of California are active in research is apparent from the reports listing literally hundreds of projects which come across my desk. For the Engineering Colleges, like the University itself, must serve the people of the state generally as well as their own students and the ideal of pure science.

Our faculty members, chosen according to these standards, are not hidden in ivory towers where students cannot find them, nor are they too busy with their own studies to counsel those who seek them out, or even to go half way to meet the more timid. Few classes in the upper division exceed thirty students, and even in the freshman and sophomore years, classes for engineers are not so large as to preclude frequent opportunity for the student to take part in discussions and to solve problems on his own. By these and other means, including ability to teach, the faculty are able to break through student apathy or inertia and to bring out the best in each individual.

Nor is the University interested in having only engineering students who are intellectual giants, possessed of the highly analytical type of mind needed for a career in research. On the contrary, it recognizes and assumes responsibility for undergraduate instruction in engineering which will meet the needs of the industries, utilities, and public works of state and nation. That it discharges this responsibility successfully is attested by the large majority of our graduates who are engaged, as is well known, not in research or teaching but in construction, exploration, service, sales, and management.

Competent Teacher-Engineers Instruct

As for the professors, almost without exception they are men competent not only as teaching scholars but also as practicing engineers. The record of their achievements on actual projects must convince even the most skeptical. Today men who are acknowledged both by the profession and by industry as highly competent engineers, and by their academic colleagues as scholarly specialists, men who are able to inspire intellectual curiosity and cultivate creative ability in their students and able themselves to make contributions to the advancement of engineering theory and practice—such men are playing a larger and larger part in determining both the programs of study and the pattern for promotion in the engineering colleges.

Other Types of Engineering Institutions

This sketch of engineering education has thus far been confined to the university level, and mainly to the University of California. In California engineering education is provided not only in universities, but in colleges and junior colleges as well. The junior colleges, for example, have developed curricula and facilities for technical training, and preparation for transfer to higher institutions,

engineering education

ROBERT G. SPROUL
President, University of California, Berkeley, Calif.

and the State Colleges are supplying courses which lie between this technical training and the professional offerings of the University.

These seem to be healthy developments, for there is room for diversity in education beyond the high school level. In America, we have liberal arts colleges and institutes of technology, publicly and privately supported institutions. These widely differing institutions, responsive to local and regional needs, expressive of the ideas and ideals of divergent thinkers, and existing in friendly rivalry and free competition, have achieved results far better, I believe, than could have been obtained under a single national plan. Out of the various ideas and enterprises of all has come an educational system sensitive to the needs of our society and alert to meet these needs in one way or another—a system, moreover, which turns out men and women who know how to live as well as how to make a living.

The criteria adopted by the State Board of Education and the University Regents, stated briefly, indicate functions as follows: for the University, the preparation of students for design and developmental engineering, with undergraduate education supported and broadened by graduate study and research; and for the State Colleges, the preparation of students for typical engineering jobs in construction, operation, application, sales and service, with emphasis on skills and techniques and the needs of a local employing clientele.

The distinguishing characteristics of the University program under this assignment of functions will be courses which prepare for broad professional activity rather than narrow occupational specialization, and facilities which provide opportunities to extend the frontiers of knowledge in engineering and allied fields. In the State Colleges, there will be a high percentage of instruction aimed directly at occupational opportunities, and more shop and laboratory work than in the University, with the necessary facilities in shops and machinery. The University, in admission and graduation requirements, staff and facilities, will meet the standards of the Engineers Council for Professional Development whereas the State Colleges will neither aim at nor seek ECPD accreditation.

This pattern of engineering education has not been the child of practicing engineers, conceived and born as a system of apprenticeship. On the contrary, it has been sired and nurtured by professional educators, and the organized engineering profession has been its product rather than its source. Yet engineering education owes much to the influence of the various professional societies, and especially of the ASCE and the Society for the Promotion of Engineering Education, in elevating the standards of the profession and in saving engineering colleges from the sin of complacency. Fortunately engineering education in the United States has had constant scrutiny, expert appraisal, and frank criticism from the major professional societies —and to its enormous benefit.

An Educator Talks Back

Perhaps I will be allowed a few frank comments in return. In reading the programs and proceedings of past meetings of the American Society of Civil Engineers I have found a curious unanimity of opinion among speakers to the effect that the prime factor in the civilization of the modern world, and in the comfort and convenience of its peoples, is the competence, initiative, capacity and resourcefulness of the civil engineer—an encouraging discovery even to me, an expatriate member of the profession. These paeans of self-praise were not infrequently combined with expressions of deep regret that the American people do not seem to be aware of the civil engineer as the indispensable man, and of the part the miracles he performs play in their lives—at least as judged from financial remuneration.

Some truth there is in this lament, of course, but I wonder how much. The average man may be ignorant of the technical knowledge and skill back of the bridge he crosses, the road on which he drives, and the automobile in which he rides, but I doubt very much if he is truly ignorant of what the engineer does to keep Nature from becoming too disorderly, and to insure that man shall live, and move, and have his being with as much ease as possible, and even with a certain degree of dignity.

Profession Widely Acclaimed

After all, the average man doesn't need to know how to build a transcontinental railroad, or an efficient sewage disposal system, to be aware of the contributions made to society through engineering and engineers. Admittedly the names of John Roebling, Theodore Judah and Harrison P. Eddy are not quite so well known to the public as those of Washington, Lincoln and Eisenhower, but their works are. It is the works after all, not the names, that are significant in engineering. Most engineers are fated to live anonymously, and not such a bad idea, I'd say, after 23 years in a job where one must be ready every morning, when he wakes up, to find himself in the headlines of the daily newspapers.

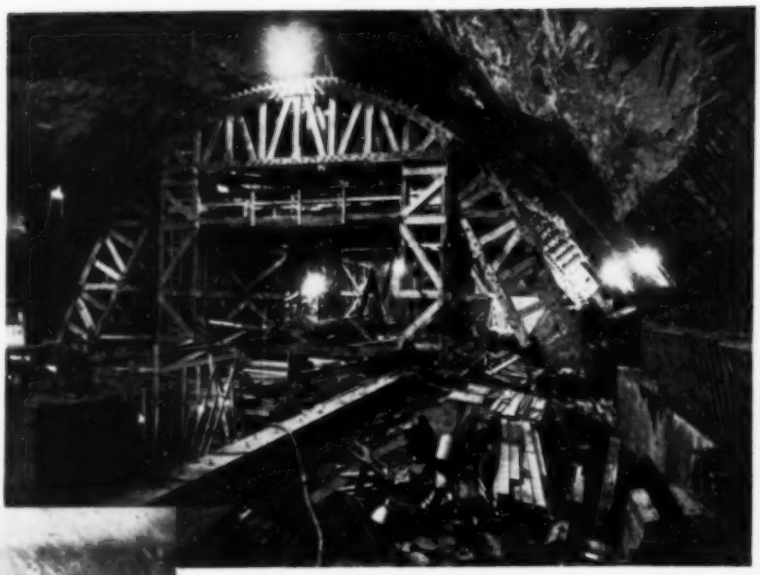
The recognition nowadays accorded the engineering profession by the general public; the almost unbelievable progress in production and industrial development, conceived and directed by engineers; the structures designed and built by engineers for the comfort, convenience, health, and efficiency of our people; and the large number of great enterprises, both public and private, managed by engineers, attest to the fruitfulness of this partnership between the engineering colleges and societies, between the engineering scientists and the engineering practitioners. These real and significant achievements are basically responsible for much of the economic and social progress of the United States.

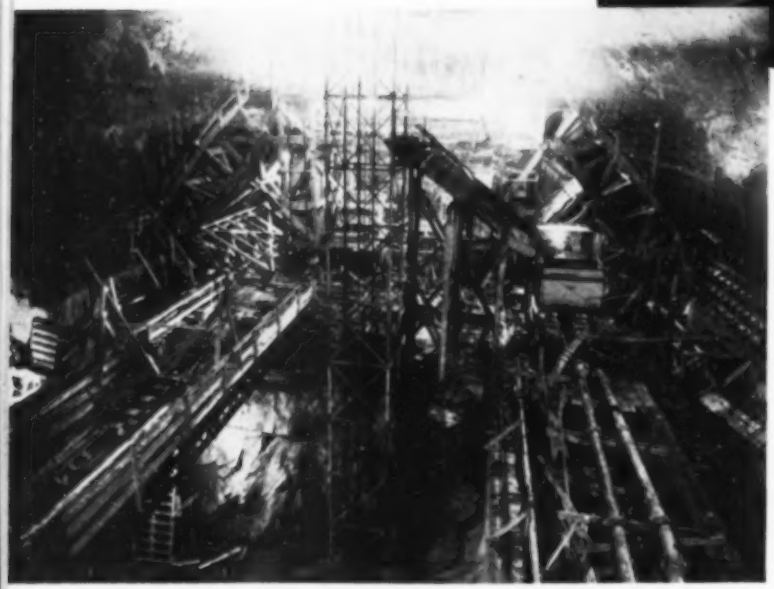
Collaboration Appreciated

We of the universities are grateful to the American Society of Civil Engineers and others for the collaboration they have given us in the solution of our difficult problems, and bespeak its continuance in the years ahead. We share your pride in the great profession of which you and we are equally a part.

(This article is taken from Dr. Sproul's address before the Membership Luncheon at the ASCE San Francisco Convention.)

Excavation for powerhouse at Kemano is as high as a 10-story building (139 ft), with width of 81.5 ft, initial length of 697 ft, and final length of more than a quarter of a mile (1,140 ft). Excavation began with two drifts running lengthwise. Perspectives (Figs. 1 and 2) give idea of complex pattern of tunnels which were drilled initially for access and to facilitate later excavation of main powerhouse chamber. Arch section was excavated first by cutting out vertical slots every 120 ft. Intermediate rock in arch was cut out using diamond drill holes 55 ft long, running horizontally between slots. Lower part of building, 81.5 by 75 ft, was excavated by holes 75 ft long, drilled vertically downward from arch section. All muck was removed through haulage drift at El. 202, which will be deepened later for tailrace tunnel. Concrete arch was placed in 30-ft sections behind collapsible traveling form, by Pumpcrete machine seen at right in view below.





Complex

out

W. G. HUBER, M. ASCE

General Manager, British Columbia International Engineering Co., Ltd., Vancouver, B.C.

With completion scheduled for mid 1954, about 3,000 construction men were engaged during the winter of 1952–1953 on the power facilities for the Alcan aluminum development in British Columbia, and this force will be increased to about 5,000 for the 1953 summer construction season. The main reservoir is filling behind completed Kenney Dam and construction equipment has been moved from that site in preparation for work on saddle dams and the main reservoir spillway along the north reservoir rim between Ootsa Lake and Skins Lake, and at Bear Lake, during 1953.

Although about 451 in. of snow fell during the winter at the west end of Tahtsa Lake, concrete work on the intake control structure and power tunnel lining continued with only minor interruptions. However, the major part of the force was occupied on excavation and concrete construction underground in the powerhouse at Kemano, advancing the main tunnel from four headings and excavating all along the underground penstocks. Articles by the author on the overall scope of the project and on the power conduits appeared in the November 1952 and February 1953 issues of Civil Engineering.

The underground powerhouse in which power developed from Kenney Dam storage will be generated is by far the largest of the type to be constructed anywhere in the world. The decision to place the penstocks well inside the mass of the mountain naturally suggested a similar location for the powerhouse, but there were several other convincing reasons for this choice of location and type of construction. Structures underground are completely safe against snow and rock slides; an unquestionable foundation is available for all equipment loads and hydrostatic thrusts, and the plant is completely protected against bombing attacks.

The main powerhouse chamber to house sixteen 140,000-hp turbine and

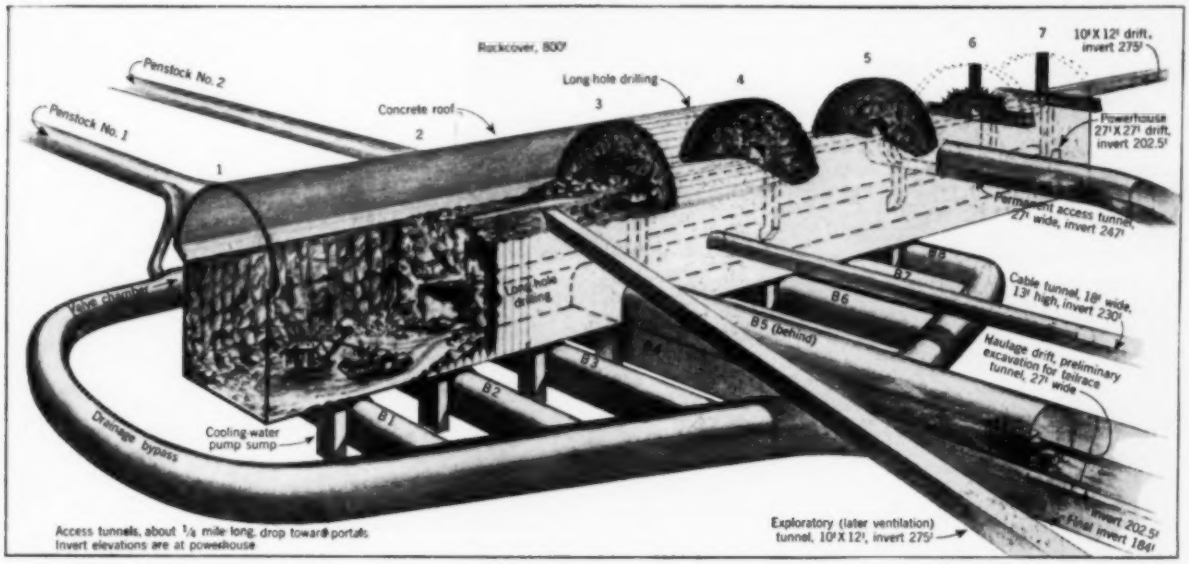
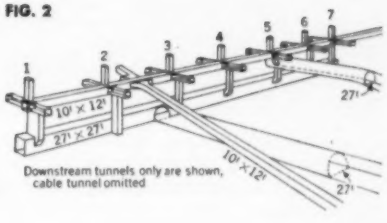


FIG. 1

excavation pattern cuts underground powerhouse

FIG. 2



generator units will ultimately be excavated 1,140 ft long by 81.5 ft wide by 139 ft high, from the bottom of the turbine discharge pits to the crown of the roof arch, except for the center section, approximately 160 ft long, to serve as the service and control bay, which will be only 118 ft in total height.

Stage 1 construction of the powerhouse (Figs. 1, 2, 3, and 4) will provide the eight bays for the northerly eight units, the service bay, and about two-thirds the length of the bay for Unit 9–a total length of 697 ft involving the removal of 260,000 cu yd of rock, solid measure. Future extension of the chamber to provide the bays for Units 9–16 inclusive, will be accomplished through the No. 2 tailrace tunnel and branches, with careful control of blasting in the area of Unit 9, which will be temporarily partitioned off from the operating service and unit bays of the powerhouse.

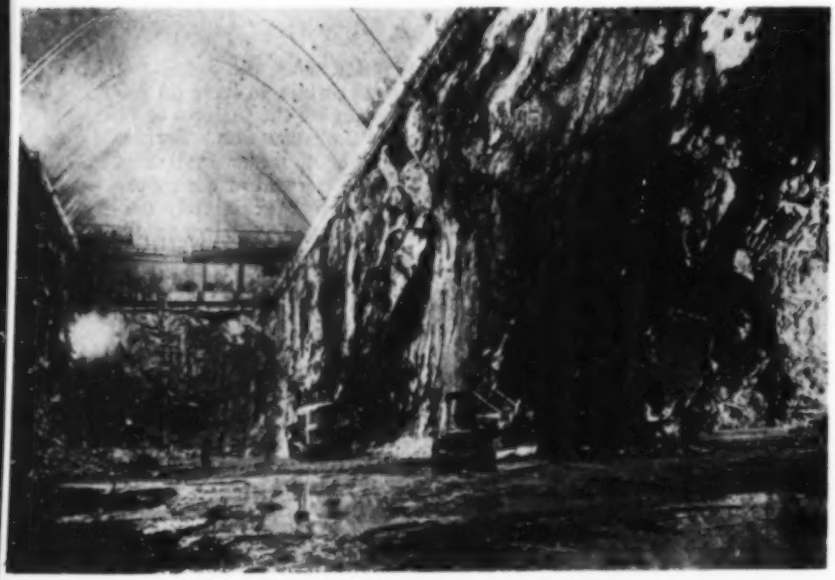
Choosing Powerhouse Location

The best general location for the underground powerhouse was obviously under the west end of Mt. DuBose, where it is accessible from a 100-acre sand-and-gravel flat along the left bank of the Kemano River. This provided a good working space through which a relatively short tailrace channel would connect with the natural channel of the river.

Orientation of the chamber within the mountain was the subject of considerable study, since the jointing of the rock was certain to have an important bearing on the surfaces to be produced by the excavation. Surface geology showed a major system of joints crossing the end of the mountain with planes approximately normal and parallel to the surface profile and a system secondary to this.

The position and character of these joint systems underground was so important from the standpoint of powerhouse design and construction planning that an exploratory drift was driven near the spring-line elevation of the powerhouse chamber at El. 280.0. This drift was run about 1,500 ft into the mountain before it encountered a body of granodiorite sufficiently large and massive to prom-

Arch concrete was placed before lower part of powerhouse was excavated. In top view, 30-ft-long section of arch concrete has been stripped. About 21,000 cu yd of concrete was pumped to make up 23 sections of roof. In middle view, joint planes uncovered in powerhouse excavation below crane-rail level, near Unit 3, are clearly evident. View below shows excavation of main powerhouse chamber looking toward north wall, in March 1953, from location of Unit 5. Recesses for eyebolts to support suspended ceiling can be seen in arch lining. Shovel of 1½-cu yd capacity and bulldozer at right of it give idea of size of excavation.



ise favorable conditions for excavation of the main chamber. A number of diamond drill holes were fanned out horizontally from niches as the exploratory drift was advanced, in order to test the quality of the rock up and downstream from that cut by the drift.

From the standpoint of plant layout, access and tailrace tunnels, connections to penstocks, and future extension of the plant, a "square" orientation appeared to have several advantages. With the rock at depth exhibiting little choice or regularity as to jointing, the main chamber was finally oriented with the long axis approximately at 90 deg from the center line of the penstocks and therefore approximately parallel to the Kemano River Valley at that point. The rock thickness above the crown of the arch is about 800 ft.

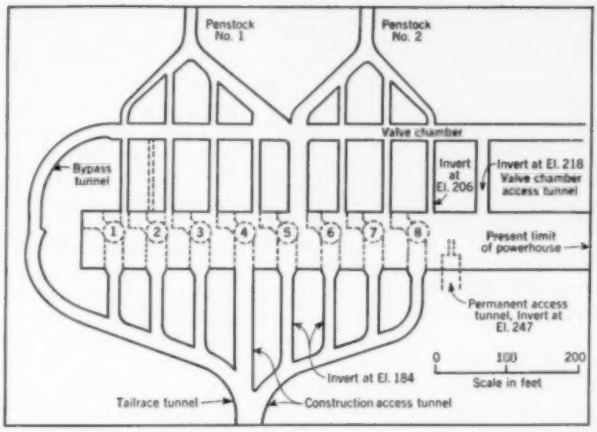
This location requires a tailrace tunnel 1,550 ft long and a main access tunnel 1,340 ft long to the portal. Investigations showed that the cost per foot of the required tunnels and high-tension cable from the powerhouse to the outside was so nearly the cost per lineal foot of penstocks on the upstream side of the powerhouse that the position of the chamber along the waterway system did not appreciably affect the overall cost.

Rock Walls Unlined

Support for the thick rock roof over a chamber of these proportions must of course be supplied by the rock forming the walls of the chamber. If the boundary of the chamber cross-section were made up of curves, it would be feasible to add substantial wall support by continuing the concrete arches from the roof to the floor of the excavation. However, with vertical walls about 75 ft high, no general structural support is practicable. In fact, the columns and girts are anchored to wall rock at their intersections and are reinforced to carry only nominal loads from local areas of wall. The four heavy floors are effective struts for completed unit bays, but no floors will be installed in the 300-ft length of the initial powerhouse reserved for future Units 4 to 8 inclusive.

Chambers of similar size have been excavated in mines. In natural caves there are rooms of comparable length, much greater width and proportionately much less rise in the arch of the roof rock. For the Kemano Powerhouse chamber, the roof loads are carried on thick walls of rock, which are continuous except for penstock tunnels on the upstream side and the tailrace, cable, and access tunnels on

FIG. 3. Plan of powerhouse shows eight units provided for in Stage 1 construction. Eight more units to south (right) are contemplated, to be served by two additional penstocks. Only Units 1, 2, and 3 are included in initial installation.



the downstream side. Some slight inward deflection of the walls is to be expected as a result of redistribution of stress, but most of this adjustment will take place soon after excavation, and any subsequent dimensional change should be too small to affect crane-rail spacing or machine settings.

The concrete roof arch will protect the equipment room against rock falls, but the controlling design loads for the arch were produced by the pressures used in grouting voids between the top of the arch and the rock. Ledges on the arch haunches carry temporary rail for construction bridge cranes spanning the entire width of the chamber, while the main powerhouse crane girders will be carried on two lines of columns spaced 50 ft on centers.

As in the Innertkirchen Plant in Switzerland and the Forçacava Plant in Brazil, a chamber wide enough for generating units and essential auxiliaries also afforded space for the main step-up transformers, but would not accommodate the turbine valves without serious undercutting of the upstream wall and special handling facilities.

Elevation of turbine runner was fixed by the maximum flood stage in the Kemano River, which had to be estimated from observations of silt deposits on large trees, since no gage records or other measurements of the river had been made before the start of construction. Clearance for venting and air entrainment in the turbine discharge pit must be maintained at all stages. The height of the chamber from the bottom of the discharge pit to the exciter floor is a function of the unit design, and the height above the exciter floor is just enough to clear the generator rotor assembly or a main transformer when it is being handled by the cranes.

Spacing of the generating units is determined by the space needed for withdrawing nozzle stems and removing the turbine runner in a horizontal position.

The turbines are four-nozzle vertical-shaft impulse wheels rated at 140,000-150,000 hp at a 2,500-ft head. They are direct-connected to 106,000–122,000-kva generators and operate at 327.5 rpm. Machine combinations are as follows: Unit 1, Canadian Allis-Chalmers turbine and Canadian General Electric generator; Unit 2, Vancouver Engineering Works (Pelton) turbine and Canadian Westinghouse generator; Unit 3, Dominion Engineering Co. turbine and English Electric Co. generator.

Bays for future Units 4 to 9 inclusive, have been excavated large enough for a duplicate of any of the three units now to be installed. Discharge pits for future units will be temporarily floored over with timber,

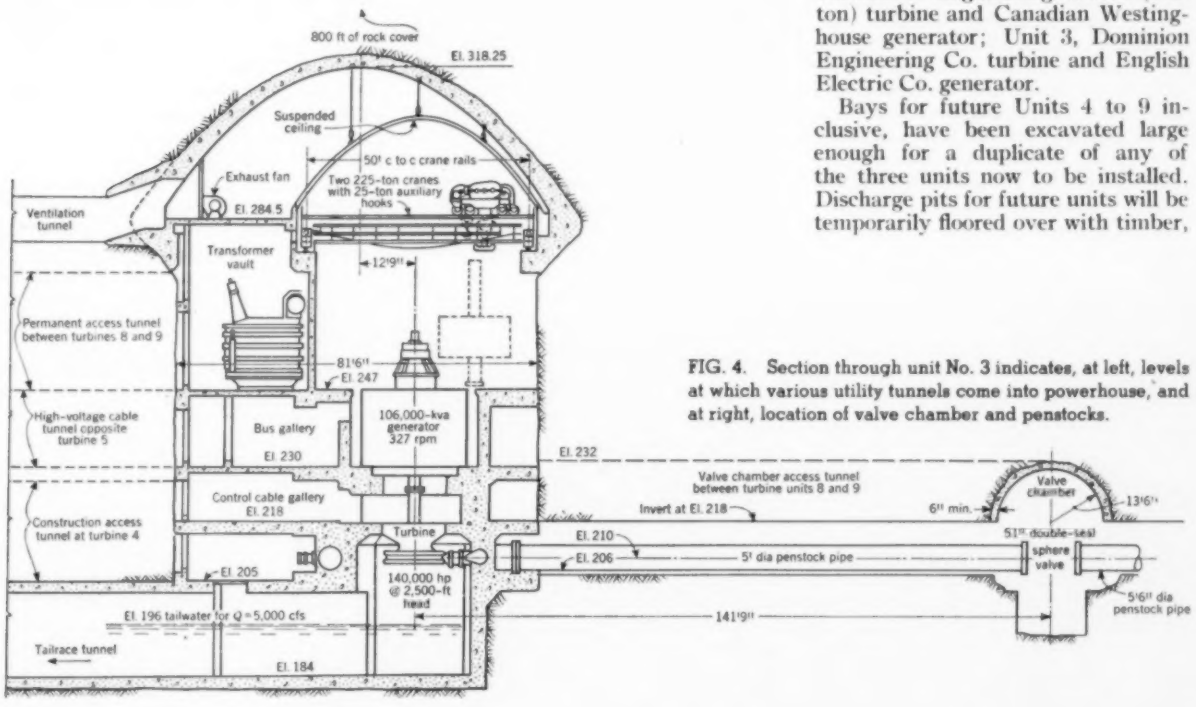
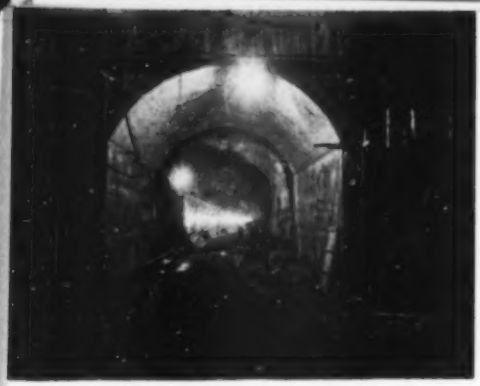


FIG. 4. Section through unit No. 3 indicates, at left, levels at which various utility tunnels come into powerhouse, and at right, location of valve chamber and penstocks.



Permanent access tunnel enters powerhouse with invert at El. 247.

and the space between pits at El. 202 will be used as erection space during the first-stage construction.

Turbine valves located in a separate chamber upstream and parallel to the main powerhouse chamber are accessible from the service and control bay at El. 218. Valves or parts can be lowered to this level by the main cranes and transferred by car to the valve chamber, along which they will be moved into position suspended between two special gantry cranes traveling with opposed booms.

Generator leads connect through 13.8-kv airblast breakers and thence through a bus made up of aluminum shapes to the primary side of the double-primary, single-phase 71,666 to 90,000-kva, 13.8/287-kv transformers. Each transformer is in a separate vault, and each bank transforms the voltage generated by two units. Initially however, any one of the three generating units can be switched to feed through either bank of transformers. No. 1 bank consists of Ferranti transformers with a spare of the same make; No. 2 bank is of Canadian English Electric manufacture.

From the high-tension bushings of these transformers, energy is conducted to the outdoor switchyard through pressure oil-filled cables carried on racks in the north half of the power cable tunnel. The south half of this tunnel is reserved for similar cable runs from Units 5 to 8 inclusive. These 301-kv cables will be approximately 3.75-in. diameter, and the runs will average 2,200 ft in length per phase. Perelli General of England are furnishing one three-phase circuit, and the other will be supplied by Canada Wire & Cable Co. Potheads terminating these cable runs will be founded on the roof of the cable tunnel extending through the outdoor switchyard located just west of the access-tunnel portal. Leads from these potheads will go through 287-kv airblast breakers and isolating switches to ACSR buses carried on an all-aluminum overhead structure, thence to the first double circuit tower of transmission line No. 1.

Auxiliary equipment in the powerhouse includes pumps at each generating unit for the supply of cooling water to the transformers, generator heat exchangers, and cooling coils for unit bearing lubrication. The main transformer vaults are arranged so that the transformers can be disconnected and run out on their own trucks to a position under the crane, which will move them longitudinally through the powerhouse as necessary for exchange with a spare transformer or for untanking and general overhaul work in the service bay. The three stories of space in the service bay below El. 247 include rooms for main oil storage and purification and the numerous storage and maintenance shop facilities, besides access to the sphere-valve chamber from El. 218.

All traffic into the powerhouse will terminate on the erection floor at El. 247, where generator assembly and maintenance will be carried on in the final phase of the development.

Special Problems Encountered

The underground design has presented rather special problems in ventilation and lighting. Fresh air for the chamber will enter through the access tunnel to a main air-conditioning and fan room just inside the powerhouse chamber and north of the access-tunnel doors. From this point, and mainly through louvers and grated openings in the floors, air will circulate through the several substructure levels and to a certain extent through the drainage and ventilating spaces provided between wall panels and the excavated surface of the chamber walls. Space between the suspended ceiling and the intrados of the structural arch serves as a plenum chamber, and air will be exhausted to the outside through the original exploratory drift, near the level of the arch spring line. Some air will be exhausted through the El. 205 floor area to the tailrace tunnels, but most of the air required for entrainment in the discharge pits will come from the outside along the crown of the tailrace tunnel.

Over the main exciter floor there will be a suspended ceiling of structural steel ribs supporting Haydite channel slabs. This ceiling will be finished off with a watertight cement paste coating to shed any drip from the structural arch. Lighting will be supplied by louvered units set into the suspended ceiling. Concrete blocks will be used in the partitions and sidewall panels in the substructure and pumice-stone blocks will make up the wall panels above El. 247.

Water for fire fighting and general plant use will be obtained from wells and stored in a chamber excavated from the rock above the ventilation exhaust tunnel. This tank storage can be supplemented by pumping directly from the tailrace manifold. Fire protection for generators and transformers consists of a system of fixed water spray nozzles with automatic and manual controls.

Two 225-ton single-trolley bridge cranes will supply hoisting service for handling all parts of the permanent equipment, which will be hauled on trailers from Kemano Bay through the access tunnel to the El. 247 level of the service bay. Ducts in the floor of the access tunnel will carry control and communication leads to the switchyard, power cables to the operators' village, and control lines for operation of the butterfly valves. A structure at the portal of the access tunnel will house diesel-engine generator sets for emergency station service power, and miscellaneous reception and guard rooms.

Only the floor of the main tailwater tunnel will be concrete lined. Outside, the tailwater channel will be lined with riprap.

Rock Excavation—A Major Task

Excavation of the labyrinth of tunnels and chambers for this powerhouse had to be started before even surface topography was completely mapped, and carried along concurrently with the design work. Orientation of the chambers to suit the jointing of the formations has been mentioned. As disclosed by excavation, jointing of the rock was favorable in some areas and adverse in others, with indications that average conditions would have been about the same for a different orientation. Relative age of formation and depth below the surface were found to be no guarantee of better quality in the rock encountered.

The 27 × 27-ft tailrace and access tunnels (Figs. 1 and 3) were driven by conventional methods and almost entirely without support. Drilling was done from a truck-mounted jumbo, and muck was loaded by self-propelled equipment into trucks for the haul to disposal dumps. In the main powerhouse chamber (Fig. 1) the general plan of excavation was from the roof downwards. From the inner end of the main tailrace tunnel, No. 4 branch was enlarged vertically so that it crossed the downstream wall of the powerhouse at invert grade El.

202. A large drift, 27 ft × 27 ft, at this level along the longitudinal axis of the chamber, provided a haulage way for muck from the arch section of the chamber.

In similar fashion, the tunnel for the penstock branch to Unit 5 was driven upstream large enough to clear the wye-branch sections of penstock manifold for Units 1–4 and future Units 5–8. The other short tunnels for penstock and tailrace branches and valve-chamber drainage were driven as men and equipment became available.

The arch section of the main chamber, from about El. 275 to the crown, was excavated southward from the extreme north end of the powerhouse. Seven 10-ft-wide transverse slots were cut at 120 ft on centers from the longitudinal center line drift at El. 275, and holes 55 ft long were drilled horizontally both ways from adjacent slots. These diamond drill holes were about 4.5 ft apart along the extrados, and 141 such holes made up the typical pattern for blasting the arch section above the spring line. Rock was blasted down progressively from the drift towards the extrados, and muck was bulldozed to shafts leading down to the haulage drift at El. 202.

Rock areas above the roof arch which were loosened by blasting were secured by long slot and wedge pins or fish bolts anchored by driving with air hammers. No trouble was experienced with ground water.

Arch Concrete Placed

As soon as the arch excavation had proceeded several hundred feet, the arch concrete was started, using built-in-place forms for the haunches and three gantry-type arch forms of 86-ft span on rails near El. 278. Each timber form was 30 ft long with hinged cantilever wings. Concrete was wet mixed in the job plant, trucked to the foot of a hoist shaft, and lifted in a skip to discharge into the hopper of a Pumpcrete machine. About 21,000 cu yd of concrete were pumped to make up the 23 sections of the roof. Forms were removed when the concrete had attained a compressive strength of about 2,000 psi.

After the arch concrete had cured for about three weeks, grout pumps were connected to a pattern of pipes embedded in the arch concrete, and the space between the concrete and the rock surface was grouted at a pressure of 25 psi to prevent any movement of loose rock. Joints between the 30-ft arch sections are built with a large groove along the inside surface which can be covered with a metal gutter to carry seepage water to the sidewalls of the chamber.

Long-hole drilling methods were employed also for excavating the remainder of the powerhouse chamber to El. 202. Vertical holes were drilled downward from the arch spring line at El. 275. A blasting sequence was established to minimize shattering of the wall rock and to open up only a small area of the wall at a shot. Holes were drilled vertically downward along the wall lines from the construction-crane rail ledge, the equivalent of line drilling on 5.5-ft centers. Pins and dowels in the walls for stabilizing the surface and anchoring building columns and beams will be placed in grout to protect the steel from corrosion by ground water.

The sphere-valve chamber was started by driving a pilot tunnel, then enlarging to full size by the long-hole drilling methods used for the arch sections of the main powerhouse chamber. The rock along this relatively small chamber broke unfavorably and the amount of concrete lining will greatly exceed that originally planned.

The 400,000 cu yd of muck obtained from rock excavation at the powerhouse level has been used to raise the area of the switchyard and construction village, to build a dike to channelize the Kemano River at higher stages, and to fill several acres to a safe elevation above high water as a possible site for the permanent operators' village.

Aggregate for powerhouse concrete is obtained from a bar in the river and from a bank at the mouth of Horetzky Creek. After crushing and screening, the river gravels make excellent coarse aggregate, but the sands, like most British Columbia stream deposits, are deficient in the finer sizes.

A high-quality gravel road extends ten miles along the left bank of the Kemano River to Kemano Bay on the Gardner Canal, where heavy docks for ships and seaplanes complete the route for all traffic to and from the plant, except for two helicopters based near the powerhouse.

Principal representatives of the owner are P. E. Radley, manager; F. T. Matthias, M. ASCE, and J. S. Kendrick, A.M. ASCE, assistant managers, Alcan B.C. Project; and K. Roestad, resident engineer. The powerhouse was designed by British Columbia International Engineering Co., Ltd., Vancouver, B.C., with C. P. Dunn, M. ASCE, president, and G. E. Crippen, chief designing engineer. N. L. Hinkson, A.M., ASCE, is construction engineer, and construction is by Morrison-Knudsen Co. of Canada, Ltd., with A. O. Strandberg, project manager.

Switchyard and Main Camp No. 5 are situated in Kemano Valley near point where tailrace tunnel issues from mountain. In this view, looking upstream (north), helicopter hangar is in left center and the several tunnel portals in right center.

Rock depths along canal route determined by seismic refraction

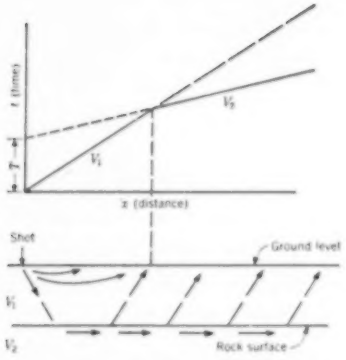
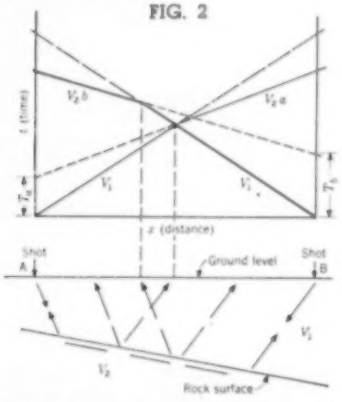


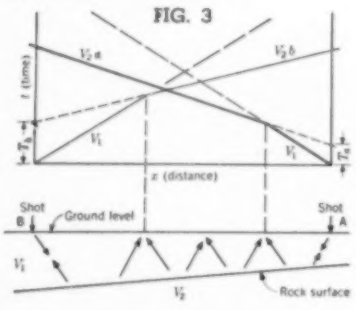
FIG. 1. Plotting for penetration of shock through single medium shows series of straight lines, slopes of which are reciprocals of velocity of sound wave. Number of straight-line segments indicates layers penetrated, and length of segments are related to the depth of each layer. Arrow points at ground level indicate approximate locations of geophones.

FIG. 2



FIGS. 2 and 3. Seismic recordings of explosions set off at both ends of spread are plotted on same graph to give profile of dips, valleys, and faults in underground rock formations.

FIG. 3



A unique method for locating subsurface rock along the site of a proposed diversion canal has recently been employed by the Wisconsin Michigan Power Co. in northern Wisconsin and upper Michigan. The canal runs from a point on the Paint River about 5 miles downstream from Crystal Falls, Mich., to the power company's Peavy Falls Pond, approximately 1½ miles away. Preliminary investigations revealed that the presence of buried boulders and erratic ledges made it difficult to determine the depths to ledge rock economically and accurately by common boring operations.

Several days were spent taking borings at random along the line of the canal without consistent results before it was decided to employ seismic equipment to make a subsurface investigation. The seismic method has been a popular and proven method for oil prospecting since its initial application in 1923.

Seismic Refraction Employed

The principle of earth shock is the basis of the geophysical method of making subsurface determinations. In the seismic refraction method, which was employed in this case, the depth is determined by ray optics using sound waves. The quantity measured is the time between the initiation of a compressional shock wave by an explosion and the first disturbance registered by the seismic detectors, which in this case were geophones located at a measured distance from the explosion point. These geophones are so sensitive that they can pick up earth vibrations from people walking and from trees swaying at distances of 200 ft.

A "spread," which was the length along the line covered by one setting of the geophones, was about 200 ft. Twelve geophones were spaced along a straight line through the explosion points, symmetrically about the midpoint, the spacing being 5 ft at the ends and approximately 50 ft at the center. This was done to get the best control of average subsurface conditions at the setting.

The compressional shock was initiated by exploding 1 lb of dynamite at a depth of 4 ft at each end of the spread. The waves from this shock cause the disturbances recorded by the detectors. Usually only the first sound wave arriving at the detector is considered, and that is the wave which has traveled the minimum time path between the shot point and the geophone. This first arrival is recorded at each detector by the recording device of the apparatus.

The circular waves initiated by the explosion spread out uniformly in a homogeneous medium with a velocity of V_1. In general the waves will continue at this velocity until they strike the underlying medium with a higher velocity of V_2. The waves striking the contact surface between media will be partially reflected back into the upper medium and partially refracted into the lower medium. When a third medium is reached, a similar split of waves will result. Each new velocity is picked up by each geophone. The travel time of the first shock wave reaching each detector is then plotted against the distance traveled.

Plottings Interpreted

This plotting gives a series of points which can be connected to give a single line or a series of straight lines. The slopes of these lines are the reciprocals of the velocity with which the sound wave traveled through the underlying layers. The number of the straight-line segments indicates the number of different layers penetrated, and the length of the straight-line segments is related to the depth of each layer. Figure 1 shows a simple example of this plotting for penetration of a shock wave through a single layer.

The reason for setting off explosions at each end of the spread was

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Blaster who sets off dynamite has control of equipment kit, which is connected to all geophones by a single cable. All current is furnished by a storage battery and a dry-cell battery.

to obtain a better picture of the underlying bends, especially in the case of a dipping bed or a fault. By plotting the waves from each of these seismic disturbances on the same graph, the dip of the beds along the profile can be determined as shown by Figs. 2 and 3. It will be seen that the distance traveled through the same media is greater for the shot at the lower end of the dip. By similar plottings, valleys and faults can be detected.

Depths to rock are computed only at points of explosion. To do this the velocity value for each layer is determined from the travel-time graph, and the zero distance-time intercept is determined for each slope segment of the graph. From these velocity values the angles of incidence and refraction at each layer interface can be determined using a fundamental law of physics—Snell's Law of Refraction—which states that

$$\sin i/\sin v = V_1/V_2$$

where i and v are the angles of incidence and refraction respectively, and V_1 and V_2 are the observed velocities in adjacent layers.

For the particular ray whose angle of refraction is 90 deg as defined by the ratio V_1/V_2, energy will travel along the boundary of the buried surface and return to the ground surface. The travel time along this path is a minimum beyond a critical distance indicated on the travel-time graph (Figs. 1, 2 and 3) by a break in the slope. Using the critical angle of incidence defined by V_1/V_2, the depth for a simple two-layer condition (Fig. 1), is computed from the expression $h = TV_1/2\cos i$,

where: T = the time interval
i = critical angle of incidence
V_1 = velocity in the first layer
h = the thickness

In all three figures t is the time scale, and T is a definite time increment for the zero distance-time intercept of each slope segment of the graph.

The field procedure adopted was that of reverse profile shooting for 200-ft spreads, at locations where the variations in the relief were not too great. Reverse profile shooting, as the name implies, uses a spread of detectors on a line through the explosion points and fires a charge of dynamite at each end of the spread, as previously explained.

Geophones Connected to Equipment Kit

The dynamite was set off by the blaster who had control of the equipment kit. The geophones were all interconnected by a cable which terminated in the recording compartment of the kit.

An amplifier filter for each of the twelve geophones is contained in the kit and receives the explosion impulse from the geophone by cable. Each amplifier is connected to an oscillograph, or galvanometer unit, and the movement of each galvanometer is reflected by a beam of light from a tiny mirror on to photographic recording paper. The camera passes the sensitive photographic paper under the light beams from the oscillograph elements at a speed of approximately 1 ft per sec.

The firing incident is put on the same record by a special circuit from the blaster which deflects one of the galvanometers at the firing instant. The time from the firing instant to the shock arrival at a geophone is measured directly from the record using a superimposed time scale. This time scale is made by a tuning fork or other oscillator breaking a beam of light at a fixed frequency. This gives a series of equally spaced time lines across the record, the spacing being a function of the oscillator frequency and the paper speed. Total exposure of the record lasts only 3 or 4 sec. The part of the film used for each shot is developed immediately in a special developing kit built into the equipment. Current for the complete operation is furnished by a storage battery and a dry-cell battery.

For this canal location study, 30 spreads were investigated, giving rock elevations at 60 locations. Whenever possible, the groundwater elevation was also recorded. These spreads were taken over a total of approximately 9,000 lin ft of possible canal route, and in no case was there more than 600 ft between spreads.

With flat-lying beds, an average accuracy of ±3 percent is commonly obtained by the seismic method for determining depth. With dipping layers, the accuracy on depth will depend on how closely a constant dip is approximated, but in general an accuracy of ±5 percent is obtained. With marked irregularities in the underlying surface, accuracy may be no better than ±20 percent. Similarly marked variations in surface elevation require corrections and, if the seismometers are not all located on the same material, the corrections applied may introduce errors in the depth calculations.

Accuracy Ratings High

Accuracy ratings for this job were tabulated as: good, ±1 ft; fair, ±2 ft; and poor, ±3 ft or more. Of the 60 settings, 50 were classed as good, or within ± 1 ft. Only 8 of the 60 settings fell within the accuracy range of ±6 percent to ±20 percent.

The work on the canal route was undertaken as a research project in cooperation with the University of Wisconsin Geology Department. The field work was completed by a crew of four men in less than nine days. It is estimated that this job, if done on a commercial basis, would have cost approximately $5,000. This represents a considerable saving over conventional drilling operations for the same area which, taking into account added costs because of extensive underground boulder formations, would have ranged from $20,000 to $30,000.

FIELD HINTS

Scour holes easily contoured for erosion experiments

C. J. POSEY, M. ASCE

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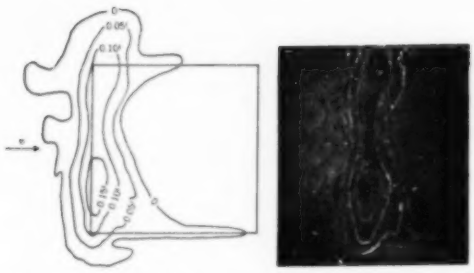


FIG. 1. Photograph taken vertically from above model after contouring is completed can be used to prepare contour map (at right). Contours represent depth of scour below bottom of square model.

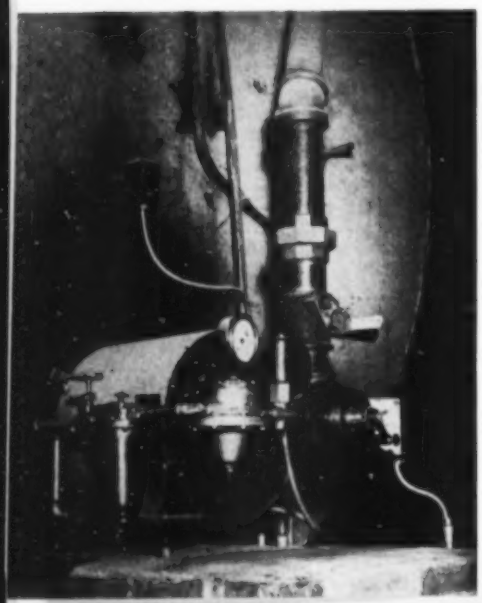
The recording of localized scour patterns in erodible-bed laboratory tests is often a difficult and time-consuming job. The depth and extent of the scour holes must be accurately measured so that they can be represented by contours. A number of schemes for doing this have been devised, but it is believed that none can compete in speed and accuracy with that used during the past summer at the Rocky Mountain Hydraulic Laboratory, Allenspark, Colo., in a series of tests sponsored by the Bethlehem Steel Company's Shipbuilding Division, of Beaumont, Tex. The tests were designed to provide basic data for the design of oil storage tanks to be used in off-shore developments.

The photographs show the procedure used in obtaining contours level with the bottom of a glass model of a square submerged barge, and at depths of 0.05, 0.10, and 0.15 ft below the

20,000-gal oil-fired tank supplies hot water for

To provide heated water for its transit-mix trucks, the Wel-Don Concrete Corp., of Westfield, N.J., has an efficient tank installation at its plant in Fanwood, N.J. The use of heated water in the mix accelerates the setting of the concrete in cold weather besides facilitating mixing. In this plant the sand and gravel are not heated prior to mixing, but any frozen lumps are thawed out by the hot water in the mixing process. The desired water temperature in the tank is 160 deg F during very cold weather and about 145–150 deg on less severe days.

Water tank of 20,000-gal capacity is heated by immersion tube 32 ft long by 10 ft in diameter, with main firing tube of 12-in. diameter. Oil-burning system consists of No. 782 Hauck proportioning oil burner with 3-hp, 16-oz blower, 1/4-hp oil pump, Wheelco electric eye and Flame-otrol, manual reset relay, and Minneapolis-Honeywell Aquastat.



The plant capacity of 750 cu yd of concrete per day supplies a fleet of 20 transit-mix trucks. These are ten-wheel Mack trucks of 6-cu yd capacity. The heated water from the tank flows by gravity to the loading stations for the trucks. The tank is refilled by pumping from a brook which frequently has ice on it during the winter in the hilly region of the Watchung Mountains where the plant is located.

Tank operation for most satisfactory and economical service has been carefully worked out. Strangely enough, the oil burner which heats the tank is not started until about 11:30 in the morning. This is because there is little loss of heat in the insulated tank over night—only 4 to 10 deg F. When the burner automatically shuts itself off at 4:30 p.m., the tank contains about 19,000 gal of water at 165 deg F.

Water used during the morning causes the tank contents to drop to about 14,000 gal by 11:30, when the burner is started. While the burner is heating the tank, a pump is refilling it at the rate of about 2,000 gal per hour. At the same time heated water is being used at the rate of 1,000 gal per hour. Thus the tank is nearly full of water at 165 deg F by the end of the work day. This water heating operation, which was devised by Alexander Genard, general superintendent of the plant, is very economical in fuel consumption and does not require operation outside of plant hours. Moreover, there is never any waiting for hot water.

The hot-water tank is insulated all around with a 3-in. thickness of magnesia block and asbestos cement with wire reinforcing. Ends of the tank are left uncovered to warm the building in which the tank, water pump, and oil-burning system are installed.

This tank, of 20,000-gal capacity, is heated by an immersion tube 32 ft long by 10 ft in diameter, with a main firing tube of 12-in. diameter leading into two 10-in.-dia return flues. The oil-burning system consists of a No. 782 Hauck proportioning oil burner with a 3-hp, 16-oz. blower, a 1/4-hp oil pump, Wheelco electric eye and Flame-otrol, with a manual reset relay

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bottom of the model. The water surface is drawn down very slowly. As it reaches the elevation desired for a contour, powdered zinc stearate is blown onto the water surface, which is then touched with a sack containing a few pieces of Aerosol OT, a surface-tension depressant, in such a way as to force the layer of dust to the shoreline.

After all the contours have been so treated, the scour hole can be photographed from above or sketched, and the zinc stearate will indicate the contour lines. Care is needed in the dusting and sketching (or interpretation of the photographs) since if the dust cover is too light, the surface-tension depressant may force much of the stearate into the capillary zone uphill from the shoreline, in which case the lower limit of the white line marks the proper location of the contour. If the stearate layer is placed too thickly, the whitened area will bump into the shore and settle with its upper edge along the contour location. These conditions, once understood, can easily be distinguished even after the bed has dried.

The contour which is level with the bottom of the model is not marked by stearate back under the model because the capillary rise keeps the water surface in contact with the bottom of the model. The position of this contour under the model can be easily seen however, as the edge of the sand that has been in motion contrasts with sand that has remained in contact with the bottom. (The line of demarcation does not show up clearly in the photograph, nor does the rest of the zero contour, since the dusting at that level was uneven.)

It should be mentioned that the test here illustrated has a much larger scour hole than could be tolerated in practice. It was found that underscour can be avoided if the model is sunk deeply enough into the bed, and that models fully exposed to the current can be protected against underscour by properly placed granular material with a correctly proportioned range of particle sizes.

With water surface at exact elevation desired for a contour, zinc stearate is dusted on (left) and is immediately forced to shore with a surface-tension depressant (right).

ready-mix concrete plant

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and a Minneapolis-Honeywell Aquastat.

The burner consumes about 12 gal of oil per hour for the five hours it operates each day, making a total daily oil consumption of 60 gal. Maximum potential capacity is available to heat 10,000 gal of water in the range from 32 deg F to 165 deg F at the rate of a 10-deg rise per hour if ever needed.

The burner is automatically shut off at 4:30 p.m. by the Aquastat actuating a solenoid oil shutoff valve. The electric-eye flame-safeguard then causes the burner blower and oil pump to shut down but remain operative. The burner does not start until a manual reset relay is operated for manual relighting at 11:30 the next morning. The burner needs no supervision once it is started.

There is no smoke or soot, as had been experienced with a different type of equipment. Proper oil-air ratio is maintained over the entire range of the burner by its automatic proportioning feature. The immersion tube has given fast and efficient heat transfer, as the firing tube is always surrounded by water to be heated, as compared with the slower heat transfer of a fire-box arrangement. The burner is mounted on a short steel-jacketed refractory ignition tile with space for induced air intake outside the tank.

This installation does not require the maintenance expense associated with conventional boiler tubes and fire-box refractories.

The heated water from the tank is also used for washing out the cement mixing units. A standpipe connection to the tank has been installed so that water will be available for fire protection for this plant and two adjoining crushed stone and paving plants no matter how cold the weather.

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

The irrigation part of a drainage project concerning 400 acres of land at Central Lafayette, Arroy, P. R., necessitated construction of 6,000 ft of 26-in.-dia high-pressure pipeline for pumping 4,000 gpm to a 10-acre-ft reservoir. The reservoir was 115 ft higher than the pump site. How would you relieve excess surge pressures which would occur in the line? For solution, see page 102.

EDITOR'S NOTE: This is the fifteenth in a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it?
H.J.G.

The above problem was submitted by WILLIAM E. LAND, A. M. ASCE, Fort Belvoir, Va.

ENGINEERS' NOTEBOOK

Equation for submerged sharp-crested weirs found

The improved Venturi flume developed by Ralph L. Parshall, A.M. ASCE, is used widely for the measurement of clear and debris laden liquids in open channels. (See Parshall's *Measuring Water*, U.S. Dept. of Agriculture, Circular No. 843, May 1950, Washington, D.C.) Submergence tests on a 6-in. Parshall flume were conducted at the Hydraulics Laboratory of the University of Wisconsin in 1950, as part of a long-term research program studying the effect of submergence on the discharge of hydraulic structures. In his article, "Submerged Weir Discharge Studies" (*Engineering News-Record*, Dec. 25, 1947), J. R. Villemonte has described the results of these tests and shown that Eq. 3, developed generally for sharp-crested weirs, appears also to apply to Parshall flumes.

The model, made of 12-gage sheet metal, was constructed in accordance with the specification of Parshall (*The Improved Venturi Flume*, Colorado Experiment Station, Colorado Agricultural College, Bulletin 336, 1928), and was mounted in a steel and glass test flume 2 ft wide, 3 ft deep and 24 ft long, as shown in Fig. 1. The inlet was well baffled, and the outlet was equipped with a circular spillway, adjustable in elevation, for the control of submergence. Upstream and downstream water levels were measured in stilling basins with point-gages, and the discharge by the direct volumetric method.

Piezometer openings for water surface measurement were drilled at Points 1 to 7, inclusive, in the side wall of the model. Points 1 and 3 are those specified by Parshall for upstream and downstream locations, respectively. Points 2, 4, 5, 6 and 7 were added so that a complete study of the optimum downstream head location could be made.

Free-Flow Tests

A total of 30 free-flow tests were completed ranging in head from 0.07 to 2.00 ft. The free-flow equation,

$$Q = 2.068h_1^{1.57} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

was developed from these data and compares remarkably well with that recommended by Parshall,

$$Q = 2.06h_1^{1.58} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In Eqs. 1 and 2, Q is the discharge rate in cu ft per sec and h_1 is the upstream head taken at Point 1, Fig. 1. The deviation of the data from Eq. 1 was less than 1 percent, which indicates the remarkably stable characteristics of the flume.

Submerged-Flow Tests

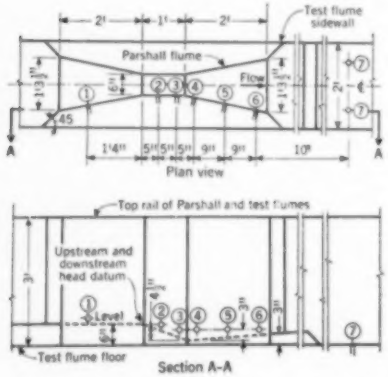
Submergence effects on the discharge rate were studied by analyzing the data from five series of constant-discharge tests. During each series the discharge rate was held constant and the submergence varied from zero to 0.99. Submergence is defined as the ratio of downstream and upstream heads. The discharge rates during submergence were computed from free-flow heads observed at the beginning and end of each constant-discharge series.

Downstream heads computed from data taken at Points 4, 5 and 6 fluctuated badly because of severe turbulence in the diffuser section. Point 2 was also unsatisfactory because at this point the contraction of the flow is incomplete. Point 3 appeared in most instances to be at the "vena contracta" and is the location recommended by Parshall for measurement of the downstream head. Point 7 was located in the test flume far enough downstream from the diffuser to be unaffected by the turbulence. Points 1, 3 and 7 are, therefore, analogous to the inlet, throat and outlet points of a Venturi meter. Since the head measurements at these points were stable and their functional relation reasonably consistent, they were used throughout the investigation.

The effect of submergence on the discharge of sharp-crested weirs can be expressed by the formula,

$$Q = kQ_1(1 - S^n)^m \quad . \quad . \quad . \quad . \quad (3)$$

where Q is the submerged discharge rate in cu ft per sec; Q_1, the free-flow discharge rate in cfs due to h_1; S, the submergence equal to the ratio of downstream and upstream heads; n, the exponent of the head in the free-flow equation; and k and m, experimental constants. The applicability of Eq. 3 to Parshall flumes is demonstrated by Fig. 2, where simultaneous values of Q/Q_1 and $(1 - S^n)$ are plotted logarithmically. The submergence S is defined as h_7/h_1, and n is taken from Eq. 1 to be 1.57. The data were not rectified satisfactorily when S was defined as h_3/h_1.



Left:

FIG. 1. Details of 6-in. Parshall flume.

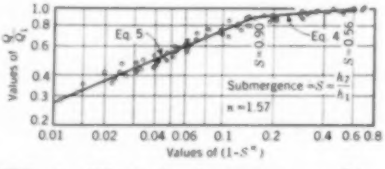
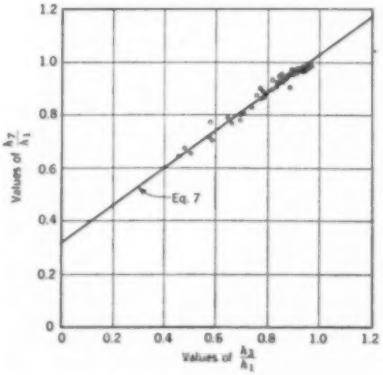


FIG. 2. Effect of submergence on 6-in. Parshall flume.

Right:

FIG. 3. Relation between h_7/h_1 and h_3/h_1



applicable to 6-in Parshall flume

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Associate Professor of Civil Engineering
VASUDEO N. GUNAJI, A.M. ASCE
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A study of Fig. 2 brings out several interesting characteristics of submerged Parshall flumes. The upstream head is unaffected until the submergence is increased to about 0.56. For the interval $0.56 < S < 0.90$ there is a strong, backward-rolling hydraulic jump in the diffuser section, and the data pertaining to it follow the formula,

For hydraulic jump in diffuser section:

$$Q = 1.05\, Q_1\, (1 - S^{1.57})^{0.09} \quad . \quad (4)$$

For $S > 0.90$ there is a series of smooth standing waves in the diffuser section, and the appropriate data follow the formula,

For standing waves in diffuser section:

$$Q = 1.20\, Q_1\, (1 - S^{1.57})^{0.435} \quad . \quad (5)$$

The change from the rolling jump to the standing waves at $S \sim 0.90$ is abrupt and, once formed, will persist for submergences less than 0.90. The criteria for the use of Eqs. 4 and 5 are, therefore, the types of flow in the diffuser section (Eq. 4 for the hydraulic jump and Eq. 5 for the standing waves) rather than the submergence intervals. The submergence at which this change occurs can be defined as the "critical submergence," so that the jump pertains to subcritical conditions and the standing waves to supercritical conditions. The submergence at which the upstream head is first affected can be defined as the "effective submergence."

Comparison with Existing Data

The submerged-flow equation proposed by Parshall is:

$$Q = 2.06 h_1^{1.58} - \left\{ \frac{0.072\, h_1^{2.22}}{\left[\left(\frac{h_1 + 10}{10}\right) - \frac{h_2}{h_1}\right]^{1.44}} - \left(\frac{h_1 - 0.184}{8.17}\right) \right\} \quad . \quad (6)$$

Comparison of Eqs. 4 and 5 with 6 can be made only if simultaneous values of h_2/h_1 and h_7/h_1 are used. Fig. 3 shows that a fairly consistent relation exists and can be expressed by the formula,

$$\frac{h_7}{h_1} = 0.320 + 0.715\, \frac{h_2}{h_1} \quad . \quad . \quad . \quad (7)$$

Table I compares the discharges by Eqs. 4 and 5 with those of Eq. 6 utilizing Eq. 7 for establishing the relation between h_7/h_1 and h_2/h_1. The agreement is close for subcritical submergences only. In the supercritical range there is a rapid deviation because the effects of submergence are entirely changed.

An equation involving the term h_2/h_1 can be developed by eliminating h_7/h_1 between Eqs. 4 and 7 and expanding the result about $S = 0.70$ in a Taylor series to give

$$Q = 1.05 Q_1 \times \left[0.844 - 0.65\, \frac{h_2}{h_1} - 0.250\, \frac{(h_2)^2}{(h_1)^2}\right]^{0.09} \quad . \quad (8)$$

which is in close agreement with, and less complex than Eq. 6.

Conclusions Listed

1. The general form of Eq. 3, developed for submerged sharp-crested weirs, can be applied to a 6-in. Parshall flume and should be applicable to flumes of larger sizes.
2. Two types of flow are associated with submerged Parshall flumes. From the point of "effective submergence" ($S \sim 0.56$) to the point of "critical submergence" ($S \sim 0.90$), a hydraulic jump exists in the diffuser section; and for submergences greater than critical, there exists a series of standing waves. For subcritical submergences, Eq. 4 applies; and for supercritical submergences, Eq. 5 applies. Equations 4 and 5 should be used for discharges corresponding to free-flow heads greater than 0.1 ft and less than 1.0 ft.
3. The results of this work compare favorably with Parshall's Eq. 6, except in the supercritical range, where Eq. 6 appears not to be valid.
4. The downstream head should be measured beyond the turbulent effects of the diffuser section—for the 6-in. model 10 ft downstream. If it is desirable to use Point 3 of Fig. 1, Eqs. 6 and 8 will apply. Equation 8 appears to be somewhat less complex.

Throughout the work many helpful suggestions were offered by Profs. J. G. Woodburn and A. T. Lenz of the Department of Civil Engineering, University of Wisconsin. Jesse D. Wilde, laboratory shop mechanic, did much of the model construction.

TABLE I. Comparison of submerged discharges by Eqs. 4 and 5 with those of Eq. 8.

Relation between h_2/h_1 and h_7/h_1 given by Eq. 7.

Upstream Head h_1	Submergence h_2/h_1	Submergence h_7/h_1	Submergence h_2/h_1	Submergence h_7/h_1	Submergence h_2/h_1	Submergence h_7/h_1	Submergence h_2/h_1	Submergence h_7/h_1	Submergence h_2/h_1	Submergence h_7/h_1	Submergence h_2/h_1	Submergence h_7/h_1
...	0.500	0.670	0.600	0.745	0.700	0.815	0.800	0.890	0.900	0.960	0.950	0.990
0.2	...	...	...	...	0.150	0.155	0.140	0.148	0.120	0.136	0.070	0.033
0.3	...	...	...	...	0.300	0.292	0.280	0.279	0.230	0.255	0.130	0.062
0.4	...	...	...	...	0.460	0.460	0.430	0.440	0.350	0.402	0.200	0.097
0.5	...	...	0.680	0.672	0.660	0.654	0.620	0.626	0.500	0.573	0.300	0.138
0.6	...	...	0.900	0.892	0.870	0.870	0.810	0.830	0.650	0.761	0.360	0.183
0.7	1.16	1.16	1.14	1.13	1.09	1.10	1.01	1.06	0.810	0.966	0.530	0.232
0.8	1.43	1.43	1.40	1.40	1.35	1.36	1.25	1.31	1.00	1.20	0.680	0.287
0.9	1.71	1.72	1.67	1.68	1.61	1.64	1.49	1.56	1.20	1.43	0.850	0.344
1.0	2.01	2.03	1.96	1.98	1.89	1.93	1.75	1.85	1.43	1.69	1.04	0.407

"Insurance" concept balances economic factors in culvert design

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Columbus, Ohio

It is well known that an engineer designing a culvert must steer a middle course between making it larger than necessary and thus wasting money, and making it too small so that it will wash out, destroying part of the road and perhaps much other property. Since there is no way of knowing in advance what the largest flow will be, it might seem that there is no way of knowing what the proper culvert size should be. But this paper is intended to point the way toward a definite answer.

Let Fig. 1 be a diagrammatic plot of the relationship between the peak flow through a culvert in any one storm, and the damage resulting from that storm. Here D is the damage in dollars resulting from a peak flow of Q cfs. When Q is not more than Q_1, there is no damage at all. A flow of more than Q_2 will cause the structure to fail and result in a damage of D_3 dollars. Suppose this will occur on the average once in T_2 years. Then the probability that it will occur in any one year is $p_2 = 1/T_2$. The annual premium to insure against this is $p_2 D_3$. It is not supposed that a highway department will actually set up a fund to cover such losses, but that in a large system the sum of the $p_2 D_3$'s would about equal the expenses due to such failures.

If the volumes of ponded water upstream from the culvert for different depths of flooding are considered as similar figures, the area flooded will vary as the square of the depth of flooding. Then we may assume that the damage will also vary as the square of the depth of flooding. In most cases we may also assume that the flow varies as the square root of the depth of flooding. Then the damage will vary as the fourth power of the flow and we may write,

$$D = k(Q^4 - Q_1^4) \quad . \quad . \quad . \quad (1)$$

for flows of from Q_1 to Q_2.

If p is the probability that in any one year any particular flow Q will be equaled or exceeded, and $p + dp$ is the probability that $Q - dQ$ will be equaled or exceeded, then the probability that in any one year there will be a flood between Q and $Q - dQ$ is dp, and the annual premium to insure against it is

$$dI = D\,dp \quad . \quad . \quad . \quad . \quad (2)$$

In order to integrate this differential equation we must have an equation connecting Q and p. Engineers long ago discovered that a plotting of discharge against the logarithm of the frequency often gave approximately straight lines. The flood discharge for small streams may be roughly approximated by

$$p = 0.5(Q_a/Q)^5 \quad . \quad . \quad . \quad (3)$$

where Q_a = average annual maximum flow.

From this $dp = -2.5\,Q_a^5\,Q^{-6}\,dQ$, and the total annual "insurance" premium is

$$I = p_2 D_3 + \int_{p_1}^{p_2} D\,dp = p_2 D_3 - 2.5\,k\,Q_a^5 \int_{Q_2}^{Q_1} (Q^4 - Q_1^4)Q^{-6}\,dQ,$$

which can be reduced to

$$I = p_2 D_3 + 0.5\,k\,Q_a^5(4/Q_1 - 5/Q_2 + Q_1^4/Q_2^5) \quad . \quad . \quad (4)$$

The last term is usually so small that we might as well write

$$I = p_2 D_3 + 0.5\,k\,Q_a^5(4/Q_1 - 5/Q_2) \quad . \quad . \quad (5)$$

To use this method we need to know Q_a, D_2, and D_3. Then for several sizes of culvert compute Q_1, Q_2, and the annual cost, finding k by letting $Q = Q_2$ and $D = D_2$ in Eq. 1, and p_2 from Eq. 3. From Eq. 4 or 5 compute I. The best design is the one that makes the sum of the annual cost of the structure and the insurance, I, a minimum.

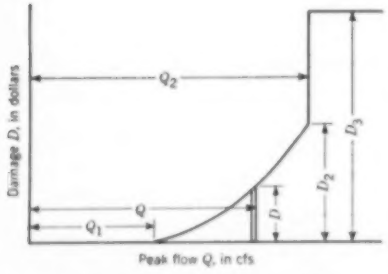


FIG. 1. Diagram plots relationship between peak flow through a culvert in any one storm, and damage resulting from that storm. Where peak flow, Q, does not exceed Q_1, there is no damage, D.

Suppose that the average annual flood on a stream is 100 cfs, and that damage due to the headwater reaching the crown of the pavement (but not overflowing it) would be $300, but damage due to washing out of the culvert under consideration would be $4,000. Suppose that this culvert will carry 100 cfs with no damage at all and that it will carry 200 cfs when the headwater reaches the crown of the pavement. Then $Q_a = 100$, $Q_1 = 100$, $Q_2 = 200$, $D_2 = 300$ and $D_3 = 4{,}000$. From Eq. 1, $300 = k(200^4 - 100^4)$ and $k = 2 \times 10^{-7}$ and $0.5kQ_a^5 = 1{,}000$. From Eq. 3, $p_2 = 0.5\left(\frac{100}{200}\right)^5 = 0.015625$.

p_1 is not required, but it would be $0.5\left(\frac{100}{100}\right)^5 = 0.50$. Then

$$I = 0.015625 \times 4{,}000 + 1000\left(\frac{4}{100} - \frac{5}{200} + \frac{10^8}{32 \times 10^{10}}\right) =$$

$$62.50 + 40 - 25 + 0.31 = \$77.81.$$

Add to this the computed "annual cost" of the culvert. Then make a similar calculation for a smaller culvert, say one which has $Q_1 = 60$, $Q_2 = 150$ and $D_3 = 3{,}500$. From Eq. 1, $300 = k(150^4 - 60^4)$ and $k = 6.082 \times 10^{-7}$ and $0.5kQ_a^5 = 3{,}041$. From Eq. 3, $p_2 = 0.5\left(\frac{100}{150}\right)^5 = 0.06584$ and

$$I = 0.06584 \times 3{,}500 + 3{,}041\left(\frac{4}{60} - \frac{5}{150} + \frac{60^4}{150^5}\right) =$$

$$230.44 + 101.37 + 0.52 = \$332.33.$$

The annual cost of this culvert will be less than that of the first one, but the sum of annual cost plus "insurance" would quite probably be more. If so, try a culvert larger than the first, with annual cost more but insurance less. The size that gives the minimum sum is the one to use.

It should be added that the basic idea of this method was suggested to the writer by his colleague Prof. P. W. Ott as early as 1945, and that it was used in a graduate class during that year, but with a different Eq. 3, and hence a different Eq. 4. The method was presented at the annual meeting of the Rocky Mountain Hydraulic Laboratory, Allenspark, Colo., August 16, 1952.

More Solutions for Intersection of Two Lines Presented

TO THE EDITOR: In the March issue, page 62, Mr. Clarke has described what he calls a simple method for finding the coordinates of the intersection of two lines, each of which is defined by the coordinates of two given points. The following method is simpler, and more direct in that tables of functions are not required.

Referring to Mr. Clarke's Fig. 1(*a*), we are given the north coordinate and the east coordinate of A, B, C and D, to find the coordinates of O at the intersection of lines $\overline{AB}$ and $\overline{CD}$. These may be computed from:

$$\left.\begin{aligned} E_o &= E_c + kb \\ N_o &= N_c + ke \end{aligned}\right\} \quad \ldots\ldots (6)$$

where

$$k = \frac{af + cd}{ae + bd} \quad \ldots\ldots (7)$$

computed from the differences in latitude and departure:

$$\begin{aligned} a &= E_b - E_a & d &= N_a - N_b \\ b &= E_d - E_c & e &= N_d - N_c \\ c &= E_a - E_c & f &= N_a - N_c \end{aligned}$$

This Eq. 7 is derived in the following steps.

We are given the north and the east coordinates of A, B, C and D, to find the coordinates of O at the intersection of $\overline{AB}$ with $\overline{CD}$.

Define the ratios,

$$k = \frac{\overline{CO}}{\overline{CD}} \quad \ldots\ldots (a)$$

$$k' = \frac{\overline{AO}}{\overline{AB}} \quad \ldots\ldots (b)$$

Using similar triangles COP and CDQ,

$$E_o = E_c + \overline{CP} = E_c + \left(\overline{CQ} \times \frac{\overline{CO}}{\overline{CD}}\right) = E_c + bk \quad \ldots (c)$$

Similarly,

$$N_o = N_c + ek. \quad \ldots\ldots (d)$$

Then working along $\overline{AB}$,

$$E_o = E_a + ak'. \quad \ldots\ldots (e)$$

$$N_o = N_a - dk'. \quad \ldots\ldots (f)$$

Equating Eqs. (*c*) and (*e*):

$$E_a = E_c + bk = E_a + ak'$$

$$ak' = bk + E_c - E_a = bk - c$$

$$k' = \frac{bk - c}{a} \quad \ldots\ldots (g)$$

Similarly with (*d*) and (*f*):

$$N_o = N_c + ek = N_a - dk'$$

$$dk' = N_a - N_c - ek = f - ek$$

$$k' = \frac{f - ek}{d} \quad \ldots\ldots (h)$$

Equating Eqs. (*g*) and (*h*):

$$k' = \frac{bk - c}{a} = \frac{f - ek}{d}$$

$$bdk - cd = af - aek$$

$$bdk + aek = af + cd$$

$$k = \frac{af + cd}{ae + bd} \quad \ldots\ldots (7)$$

Application to Mr. Clarke's data can be illustrated by a slide-rule computation:

$$k = \frac{(380 \times 178) + (-89 \times 84)}{(380 \times 253) + (264 \times 84)} = 0.506$$

$$E_o = 1{,}625 + (0.506 \times 264) = 1{,}759$$

$$N_o = 1{,}523 + (0.506 \times 253) = 1{,}651$$

There are two simple ways to check. One is to close lines AO and OB; the tangents should be equal. The other is to exchange A, B with C, D, compute a k' from Eq. 7 and run from A to O with Eq. 6. If lengths of lines are required, then,

$$\overline{CO} = k\overline{CD};\ \overline{AO} = k'\overline{AB}$$

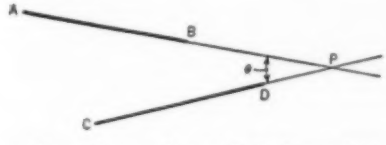
The method applies to external intersections. If O is southwest of C, $k < 0$; if northeast of D, $k > 1$.

R. ROBINSON ROWE, M. ASCE
(*N. G. Neare*)

Sacramento, Calif.

TO THE EDITOR: A simple method I have developed for computing the point of intersection of two lines follows:

The two lines determined by the segments $\overline{AB}$ and $\overline{CD}$ intersect at point P and subtend the angle θ.



Given the coordinates of the four points:

$$\begin{aligned} A &= (x_1, y_1) & C &= (x_3, y_3) \\ B &= (x_2, y_2) & D &= (x_4, y_4) \end{aligned}$$

To determine the angle θ and the coordinates of point $P = (x_0, y_0)$

For convenience in the work to follow, write

$$\begin{aligned} X_{21} &= (x_2 - x_1) & Y_{21} &= (y_2 - y_1) \\ X_{32} &= (x_3 - x_2) & Y_{32} &= (y_3 - y_2) \\ X_{41} &= (x_4 - x_1) & Y_{41} &= (y_4 - y_1) \\ X_{43} &= (x_4 - x_3) & Y_{43} &= (y_4 - y_3) \end{aligned}$$

and note as a numerical check that

$$\begin{aligned} X_{21} + X_{32} + X_{43} &= X_{41} \\ Y_{21} + Y_{32} + Y_{43} &= Y_{41} \end{aligned}$$

Compute by the usual formulas,

$$\left.\begin{aligned} \overline{AB} &= \sqrt{X_{21}^2 + Y_{21}^2} \\ \overline{CD} &= \sqrt{X_{43}^2 + Y_{43}^2} \end{aligned}\right\} \quad \ldots\ldots (1)$$

$$\left.\begin{aligned} \overline{AB} \cdot \overline{CD} \cdot \cos\theta &= X_{21}X_{43} + Y_{21}Y_{43} \\ \overline{AB} \cdot \overline{CD} \cdot \sin\theta &= X_{21}Y_{43} - X_{43}Y_{21} = \Delta, \text{ say} \end{aligned}\right\} \quad (2)$$

Also write

$$\left.\begin{aligned} \overline{AP} &= i\overline{AB} \\ \overline{PB} &= (1 - i)\overline{AB} \\ \overline{CP} &= (1 - j)\overline{CD} \\ \overline{PD} &= j\overline{CD} \end{aligned}\right\} \quad \ldots\ldots (3)$$

in which i and j are numerical factors, determined as follows:

By elementary geometry

$$\left.\begin{aligned} x_0 &= (1 - i)x_1 + ix_2 \\ y_0 &= (1 - i)y_1 + iy_2 \\ x_0 &= jx_3 + (1 - j)x_4 \\ y_0 &= jy_3 + (1 - j)x_4 \end{aligned}\right\} \quad \ldots\ldots (4)$$

or, eliminating x_0 and y_0, and rearranging, Eqs. 4 become

$$\left.\begin{aligned} iX_{21} + jX_{43} &= X_{41} \\ iY_{21} + jY_{43} &= Y_{41} \end{aligned}\right\} \quad \ldots\ldots (5)$$

when solving for i and j by Cramer's rule,

$$\left.\begin{aligned} i &= \frac{X_{41}Y_{43} - X_{43}Y_{41}}{\Delta} \\ j &= \frac{X_{21}Y_{41} - X_{41}Y_{21}}{\Delta} \end{aligned}\right\} \quad \ldots\ldots (6)$$

in which Δ is given by Eq. 2.

As an independent check, Eqs. 4 can be solved directly for $(1 - i)$ and $(1 - j)$. To this end, it is necessary only to write $-X_{32}$ for X_{41}, and $-Y_{32}$ for Y_{41} in Eqs. 6, giving

$$\left.\begin{aligned} (1 - i) &= \frac{X_{43}Y_{32} - X_{32}Y_{43}}{\Delta} \\ (1 - j) &= \frac{X_{32}Y_{21} - X_{21}Y_{32}}{\Delta} \end{aligned}\right\} \quad \ldots\ldots (7)$$

Inserting the values of i and j, just found, into Eqs. 3, the required lengths $\overline{AP}$, $\overline{PB}$, $\overline{CP}$, $\overline{PD}$, follow immediately, with an independent check; and using those values in Eqs. 4, gives the coordinates x_0 and y_0, also with a check.

JOHN L. NAGLE
Director, Real Property
Public Buildings Service

Washington, D.C.

SOCIETY NEWS

Proceedings Separates to Be Photo-Offset

Technical Divisions Chart a New Course

Beginning in October, the Society is undertaking a new procedure for distributing its technical papers—designed to expedite their issuance and also to permit output of more papers. As noted in the April issue (page 67), a revised method of printing and distributing Proceedings Separates was adopted by the Board of Direction at its San Francisco meeting upon recommendation of the Committee on Publications. One of the early Proceedings Separates to appear under the new system will be a detailed instruction pamphlet for the guidance of authors, Division officers, and members. Until such a pamphlet can be perfected, this preliminary statement will serve to facilitate the transition to the new procedure.

Briefly, the plan is to accept every paper cleared by a Technical Division and (without editing or more than cursory examination at Society headquarters) send it to a photo-offset printer for direct reproduction. Proceedings papers will be distributed *automatically*, about the fifteenth of each month to members of the Society enrolled in the Division recommending the paper. By a postcard canvass currently in the mail, every member is being asked to enroll in the *one* Technical Division of his choice.

If necessary, the printer may be authorized to retype the text matter, proofread it, and proceed with the photo-offset printing without further reference to author or editors. Time will be gained by authors who submit original manuscripts typed well enough to permit photo-offset reproduction. This will prevent recopying errors, and the paper will appear exactly as submitted by the author. Sharp, black-and-white manuscript is required.

The two most common type faces in typewriters today are called "pica" (10 character spaces per inch) and "elite" (12 character spaces per inch). When using "pica" typewriters, the typing on each sheet should be confined within a box $5^7/_8$ in. wide by $9^1/_8$ in. high, double spaced, including the line reserved for the page number. When using "elite" type, the corresponding box should be $4^7/_8$ in. wide by $8^1/_8$ in. high. The dimensional box, of course, should not be visible to the camera.

Reproduction of drawings presents a problem and requires conformity to instructions. Each illustration should be drawn within a text "box" of the same size used for the typing. Large tracings or other large drawings cannot be used. They should be broken up, with selected parts presented as separate figure numbers, to demonstrate points argued in the text. Photographs should not be submitted unless absolutely necessary to prove a point. Illustrations should not be submitted in quantities greatly in excess of text.

The procedure can be a success if contributors will assist in condensing their subject matter as much as possible. An average length of 12,000 words or their equivalent is envisaged. Manuscripts exceeding this limit probably will require special clearance by the Publications Committee of the Board of Direction. Preference will be given contributors who are members of the Society.

Three monthly issues each year will be kept available for papers to be presented at Society Conventions. Convention papers, recommended by a Division for publication, will be made available at the Convention, if acceptable copy is received at Society headquarters 45 calendar days in advance of the Convention.

All correspondence offered as discussion should be mailed to the Manager of Technical Publications at ASCE headquarters, 33 West 39th Street, New York 18, N.Y. Discussions will be published as promptly as possible. The active discussion period of three months will not be changed.

Each member enrolled in a Technical Division will receive free and automatically all papers sponsored by that Division. Members enrolled in other Divisions may purchase papers at a cost of 25 cents each.

The best of the Proceedings papers will be selected for the permanent record—the annual TRANSACTIONS. These will be edited in accordance with traditional Society standards and issued in printer's type as at present. They will have all the advantages inherent in the printed book, including eligibility for Society prizes, and a comprehensive listing in author and subject indexes.

Engineers and Scientists in Bureau of Standards Study

A nine-man committee of engineers and scientists has been appointed, at the request of Secretary of Commerce Sinclair Weeks, to make a "thorough, objective, and impartial" examination of the U.S. Bureau of Standards. The survey of Bureau of Standards operations was requested as the result of a controversy that arose over recent efforts of the Department of Commerce to force the resignation of Dr. A. V. Astin, director of the Bureau, in a dispute over the Bureau's testing of a battery additive.

The committee is headed by Dr. M. J. Kelly, of the Bell Telephone Laboratories, representing the National Academy of Sciences. ASCE is represented by Dr. Abel Wolman, of Johns Hopkins University, who was appointed by President Huber.

Other committee members are Dr. Lee A. Dubridge, president of the California Institute of Technology, representing the American Institute of Physics; Dr. Guy Suits, vice-president of the General Electric Co., representing the American Institute of Electrical Engineers; Dr. William L. Everitt, dean of engineering at the University of Illinois, representing the Institute of Radio Engineers; Dean Kenneth S. Pitzer, of the University of California, representing the American Chemical Society; Dr. Clyde Williams, director of the Battelle Memorial Institute, representing the American Institute of Mining and Metallurgical Engineers; Dr. James W. Parker, of the Detroit Edison Co., representing the American Society of Mechanical Engineers; and Prof. J. Barkley Rosser, of Cornell University, representing the Policy Committee for Mathematics.

EJC Denied Right to Incorporate

Constituent Societies Said to Be "Non-Professional"

Recent efforts of Engineers Joint Council to incorporate have been defeated by failure of the New York State Legislature to pass the amended Morgan Bill that would have given EJC the right to incorporate under the laws of the State of New York. Made up of representatives of eight engineering societies, EJC had sought to incorporate in order to better conduct its non-profit operations and to carry out its cooperative functions in advancing the science and profession of engineering. The EJC constituent societies are ASCE, AIME, ASME, AIEE, AIChE, ASEE, SNAME, and AWA.

Under the New York Education Law, no "corporation hereafter formed [may] use or assume a name involving the word *engineer* or *engineering* or any modification or derivation of such terms except a non-profit membership corporation composed exclusively of professional engineers." ASCE and the other Founder Societies were incorporated before passage of the present law. However, they could not now be incorporated unless all their members were registered to practice engineering. Many members of the constituent societies of EJC, all engineers, are not licensed, nor are they required by law to be licensed in order to practice engineering. EJC therefore sought passage of an amendment to the Education Law that would permit its incorporation. The proposed amendment was introduced in the State Senate by Senator Williamson, and in the Assembly by Justin Morgan.

The Legislative Committee of the New York State Society of Professional Engineers opposed the incorporation of EJC, in the closing days of the recent Legislature. This was done by dispatching, on March 14, 1952, the following telegram to all state senators and assemblymen and indicating it to be the "unanimous action Special Legislative Committee our Society":

Telegram

"New York State Society Professional Engineers vigorously opposes passage amended Morgan Bill, Assembly introductory 2830, seeking incorporation Engineers Joint Council for following basic reasons use of name engineers in corporate title could mislead public as to true status of corporation and its membership by implying they were licensed professional engineers New York State and would contravene express prohibition contained Section 7209 Education Law stop Despite apparent innocuous purposes this bill Engineers Joint Council reorganized only this year to take over without sanction administration of engineering profession is coordinating agency for various national non-professional technical societies approximately ten percent of whose total membership throughout country are professional engineers with another ten percent foreign nationals residing abroad stop This bill bold invasion of our learned profession by non-professional out of state groups seeking to dominate engineering profession in New York stop No legitimate reason exists for use of word engineers in title this corporation any more than use of words lawyer or doctor in non-professional corporations which certainly would not be tolerated in New York stop For protection engineering profession this state and prevention its domination by non-professional groups we respectfully urge you vote against this bill which is one of several submitted this session by various interests including foreign corporations seeking directly and indirectly to limit or destroy the New York engineering license law.

"NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS

"Edward J. Nunan, *President*"

Though the amendment failed of passage, EJC will continue steps to incorporate in New York or elsewhere.

New England Council of Sections Organized

To the growing list of District Councils formed within the Society to facilitate discussion of ASCE functioning at Local Section level and to expedite Section operation has been added a New England Council, which held its first annual meeting at Northeastern University in Boston on May 2. With ASCE Director Frank A. Marston temporarily in the chair, Neil D. McDowell, of the Maine Section, was elected chairman of the Council for the coming year. Serving with him will be Earl R. Howard, of the Connecticut Section, as vice-chairman, and Ernest L. Spencer, of the Northeastern Section, as secretary.

Held simultaneously with the annual New England Conference of Student Chapters, the session first studied operation of the student prize paper competition, for the past sixteen years a feature of the New England Conference, previous sponsoring group for the competition. It was decided that, in the future, entrants will be judged equally on subject matter and presentation, with no restriction on the numbers of awards to any one school, as in the past. Certificates will be awarded to winners of first, second, and third places, and there will be three honorable mention awards.

The Council also discussed the possibility of sponsoring a prize paper competition for Junior Members. With the trend in Society operation toward reducing the number of Conventions in favor of more regional meetings, the possibility of the new Council's sponsoring such a meeting jointly with a meeting of one of the Technical Divisions was discussed. Vice-Chairman Howard was appointed chairman of a Program Committee to give further thought to the matter.

The New England Council will meet again at the M.I.T. Faculty Club on June 22, at 5 p.m.

Attending first annual meeting of the newly formed New England Council of Sections, held at Northeastern University in Boston on May 2, are (left to right, first row) Neil D. McDowell, Maine, elected chairman for the coming year; Frank A. Marston, ASCE Director, District 2; Allen Richmond, assistant to the Secretary of ASCE; and Earl R. Howard, Connecticut, elected vice-chairman and Program Committee chairman. Second row (same order) shows Prof. D. C. Drucker, Providence; Dr. Hamilton Gray, Maine; John F. Willis, Connecticut; Prof. Ernest L. Spencer, Northeastern, elected secretary; Prof. John B. Wilbur, Northeastern; and Waldo Smith, Providence.

New officers for Pacific Northwest Conference are (left to right) Fred H. Rhodes, Jr., chairman; Harold Doolittle, vice-chairman; Hamilton K. Johnson, secretary-treasurer; and ASCE Director Glenn W. Holcomb. Spokane Section will be host to next year's Conference.

West Coast Projects Are Studied at Conference of Northwestern Sections

The economic aspects of a number of engineering topics, with particular attention to local projects, were considered by the Pacific Northwest Conference of Sections, held in Seattle, May 1 and 2, with the Seattle Section as host. The two-day meeting attracted an attendance of 240 delegates from Washington, Oregon, and Idaho. Next year's conference will be held in Spokane.

Highlighting the two technical sessions was an address by L. E. Karrer, executive vice-president of the Puget Sound Power and Light Co., who told the engineers that the federal government should not get out of the power business immediately because the Pacific Northwest is facing the threat of an increasingly serious power shortage. "The hard fact is," he remarked, "that if the federal government were to withdraw immediately from the field of building power plants in this area, a vacuum would be created, the consequences of which I hesitate to contemplate." No other agency, either public or private, could step in "overnight" and complete present projects or get those urgently needed under way. Mr. Karrer said. He added that the government had provided a "walking stick" in the form of Grand Coulee and other depression developments, but that the federal program has become a crutch. "We must learn to walk again before we throw away that crutch or before it is withdrawn," Mr. Karrer emphasized. "Otherwise, we will fall flat on our face."

W. A. Averill, vice-president and publisher of the *Pacific Builder and Engineer*, was the keynote speaker at the opening luncheon in the Olympic Hotel. In analyzing the economy of the Northwest as it affects the civil engineer, he pointed out that the area has a construction program for 1953 in the three-billion-dollar bracket.

In a talk on commercial atomic energy, given at the banquet that closed the conference, Prof. L. R. Donaldson, of the University of Washington, said that 6,500 of the 450,000 engineers practicing in the United States are working for the Atomic Energy Commission. Other speakers discussed the economics of the proposed Trans-Puget Sound Bridge, natural gas, air traffic, highways, freeway planning, the Port of Seattle, and industrial relations.

Conference officers were James E. Travis, chairman; Byron J. Clark, vice-chairman; and M. B. Nelson, secretary-treasurer. New Conference officers, elected during the meeting, are Prof. Fred H. Rhodes, Jr., of Seattle, chairman; Harold J. Doolittle, of Spokane, vice-chairman; Hamilton K. Johnson, of Seattle, secretary-treasurer; and ASCE Director Glenn W. Holcomb, of Corvallis.

EMC Calls for Higher Education in Scientific Age

In discussing the importance of technological manpower before the annual meeting of the American Institute of Chemists on May 13, Dr. T. H. Chilton, chairman of the Engineering Manpower Commission of Engineers Joint Council, said that the problem of manpower shortage has too often been handled in a merely statistical manner which, he pointed out, encourages the diminution of some of the more important aspects of the situation. In the final analysis, he commented, we are not dealing with mere numbers but with men and women, who themselves are giving more and more consideration to development of their own technological careers.

According to Dr. Chilton, "we have tended to overlook the most significant forces behind the ever-growing demand for technological personnel." Among these forces, he listed the growing complexity of modern industry and the consequent demand for technological personnel in a larger employment area where their technological skills are needed for adequate performance. In certain industries, for instance, such people are needed for sales market analysis and similar fields.

The manner in which science must grow is important. Dr. Chilton stated, pointing out that every single new discovery has not been an end in itself but has revealed hundreds of new possibilities that await investigation. He indicated that, in an expanding industrial structure, where the ratio of engineers to gainfully employed workers is approaching one to fifty, the number of gainfully employed workers is insufficient, providing a fundamental reason for the increase in the demand for engineers and scientists.

Attributing the current shortage in this age of science to "the amazing fact that we have neglected science education, especially at the high school level," Dr. Chilton said that the responsibility for the situation must, to a large extent, be accepted by the engineers and scientists themselves because it is too much to expect that persons outside these fields will be acquainted with the needs in education of science and engineering.

For those who caution against overloading the engineering and scientific manpower markets, Dr. Chilton pointed out that even if proportionately every youngster talented in science and engineering entered these curricula, the maximum number of graduates we could have would be in the neighborhood of 45,000 to 50,000—a number equal to the 1950 graduating classes, which proved unequal to the technological demand. In this age of science, Dr. Chilton concluded, we are doing our talented youth a disservice if we do not acquaint them with the unlimited opportunities for service and development in science and engineering.

Civil Engineers' Income Found Lowest in the Profession

With a median annual income of $7,100, the civil engineer is the lowest paid in the engineering profession, according to a recent report of the Bureau of Labor Statistics, entitled *Employment, Education and Income of Engineers,1949–1950*. Based on a survey made by the Engineers Joint Council for the Department of Defense, the report deals largely with members of full professional grade in the then five constituent EJC societies. Questionnaires were sent to 55,000 engineers, 35 or older, who were asked to supply information on their field of specialization, their three highest fields of competence, their education, present work, and income.

Of the group surveyed, 29.1 percent were in the $5,000–$7,000 salary range; 25.1 percent in the $7,999–$9,000 range; and 14.4 percent in the $9,000–$11,000 range. The median salary for the electrical and mining branches of the profession was found to be $8,000; mechanicals, $8,400; and chemicals, $9,100. In every category, the survey showed engineers with doctors' degrees receiving the top salaries. The report also notes that since "income tends to increase with age and to be highest among engineers in private industry, it is believed that if there is any bias at all, it resulted in a slight understatement of the earnings level of all members of engineering societies 35 years of age and over."

More civil engineers—42.8 percent—are employed by governmental agencies, that is, by the United States, states, counties, cities and districts, than in any other type of work, and the second highest number, 34.5 percent, is in private industry. For the profession at large, the figures are reversed, with private industry employing 65.8 percent of all those reporting, and the government second with 17.1 percent of the employees.

Copies of the report are available from the Bureau of Labor Statistics, 14th Street and Constitution Avenue, Washington 25, D.C.

Student Chapters Receive Committee Commendation

Awards of Certificates of Commendation and Letters of Honorable Mention, given annually to Student Chapters for outstanding activity in the current school year, have been made for 1952 by the ASCE Committee on Student Chapters and announced by President Huber. The Chapters receiving Certificates of Commendation, with the number of times they have been thus honored are:

Virginia Military Institute (17th time)
Carnegie Institute of Technology (11th time)
Northeastern University (8th time)
University of Colorado (7th time)
California Institute of Technology (5th time)
South Dakota State College (5th time)
University of Arizona (4th time)
Manhattan College (4th time)
Lehigh University (3rd time)
University of Florida (2nd time)
Georgia Institute of Technology (2nd time)
University of New Hampshire (2nd time)
University of Cincinnati (1st time)
University of Illinois—Navy Pier Branch (1st time)
Northwestern University (1st time)

Student Chapters receiving the Letter of Honorable Mention are as follows:

Bucknell University
Catholic University
Clarkson College of Technology
Colorado A & M College
Cooper Union
Fenn College
Iowa State College
Kansas State College
University of Kentucky
Louisiana Polytechnic Institute
Massachusetts Institute of Technology
University of Massachusetts
Missouri School of Mines and Metallurgy
North Carolina State College
Ohio Northern University
Ohio State University
Oregon State College
Purdue University
Rose Polytechnic Institute
Rutgers University
Swarthmore College
Texas Technological College
University of Texas
Tufts College
University of Virginia
Washington State College
University of Washington
University of Wisconsin
Worcester Polytechnic Institute

Three Certificates are awarded in each of the five geographical regions into which the present 134 Chapters are divided for administrative purposes. Similarly up to six Letters may be awarded in each region. The formal scoring system developed and applied by the Committee on Student Chapters takes account of many different Chapter activities.

Metropolitan Section Forms Sanitary Group

A Sanitary Engineering Group is being set up within the Metropolitan Section to function in furtherance of aims of the Society's Sanitary Engineering Division. Approval of the new group was given by the Metropolitan Section Board of Directors at its April meeting, and rules of procedure were since formulated and passed on by the local board at its May session.

The group's potential membership totals 350 within the Metropolitan Section who claim sanitary engineering as their prime technical field. Persons outside ASCE, but having common professional interests with the group, will be considered for non-voting alliance as associates, according to present plans.

While the 1953–1954 program is not yet defined, the group has already conferred with A. J. Fischer, the Sanitary Engineering Division's program chairman for the New York Convention in October, concerning possible assistance it may give him on either technical sessions or social events under consideration.

An executive committee of six plus a secretary-treasurer has been appointed by the temporary organizing committee. Those named to the executive committee are Torris Eide, Richard Hazen, Arthur Herberger, Prof. William Ingram, William A. O'Leary, and Robert M. Pope. Alex Diachishin was named secretary-treasurer. The executive committee will elect its own chairman and vice-chairman.

EJC Annual Report Ready

Operation and activities of Engineers Joint Council in 1952 are described in the EJC report for the year. The three-part report also contains the constitution and standing committees for 1953. Reported highlights of the year included a decision to broaden the scope of the organization by including in its membership all the eligible engineering societies wishing to join; ratification of a new constitution; and appointment of a permanent secretary.

Copies of the report are obtainable from T. A. Marshall, Secretary of EJC, at 29 West 39th Street, New York 18, N.Y.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Reorganization of the Executive Branch of the government is actively under way. Some of the proposals vitally affect the engineering profession. All of them are of interest to the engineer as a citizen and as an advocate of efficient management. Reorganization Plan No. 1 created the new Department of Health, Education and Welfare under a Cabinet Secretary, an Under-Secretary and two Assistant Secretaries. There is also a special assistant to be selected from leaders in the medical field to review health programs.

Abolition of the National Security Resources Board is proposed, its functions to be transferred to a new, enlarged, and permanent Office of Defense Mobilization. NSRB is a typical example of a "standby" agency which failed to rise to the greater heights required of it when the sort of crisis it was designed to handle actually arose.

The huge Defense Department itself is to have a major shakeup with far greater powers concentrated in the Secretary. Among the agencies to be abolished are the Munitions Board, Resources and Development Board, and the Office of Director of Installations. This new plan will become effective June 30, subject to prior veto by either house of Congress. The plan elevates the civilian authority further above the military in several important areas. Six new assistant secretaries would be appointed. One of these, the Assistant Secretary for Properties and Installations, would direct construction planning of vital interest to the engineering profession and the construction industry. The present Office of Director of Installations has been very helpful to Congressional committees, and some question has arisen over disrupting this function.

Added powers have been given by Executive order to the Chairman of the Civil Service Commission over personnel management policies at White House level. The previous arrangement of a separate personnel officer on the White House staff ran into serious difficulties during the last administration.

Still another Reorganization Plan would abolish the Board of Directors of the Export-Import Bank placing all authority in a single managing director.

Not all reorganization plans stem from the White House under the Reorganization Act. Department and bureau heads are working on detailed problems in their own fields. For example, Secretary McKay of the Department of the Interior has commenced a major adjustment of the Department command. The first step involves various field coordinating committees dealing with major river basins which now act under the program staff of the Secretary's office. The reorganization involves discontinuance of the program staff and of several divisions in the Department. Consolidation of all public information activities and of all legal work of the various bureaus is also contemplated. It is said that a saving of $250,000 per year may result from the changes already ordered. Other reorganization plans under study both in major agencies and in scattered bureaus will be mentioned next month.

A bill passed by the Senate and being considered by a House committee (S. 106, H.R. 992) would establish a Commission on Organization of the Executive Branch of Government, thus continuing the work of the Hoover Commission. It would also be charged with making recommendations for elimination of duplicating activities and services.

Water Policy and Projects

The St. Lawrence Waterway controversy goes on unabated. The White House announced approval by a special Cabinet committee of participation in the Seaway by the United States, subject to assurance that the underlying power project will go ahead, that Canada will proceed with its part, and that the project be set up as self-liquidating.

A preliminary decision in favor of New York State's application to join with Canadian interests in building the power project was rendered toward the middle of May with 20 days allowed for filing exceptions. The Canadian Government has expressed a willingness to undertake the project alone, at least if it can get the necessary cooperation on the development of the power project. In a recent meeting with President Eisenhower, the Canadian Prime Minister urged an early start on the project. Remarkable mineral developments are rapidly bringing to Canada prospects of great wealth and a confidence in its ability to play a greater part in North American development. As an example, Labrador iron-ore shipments of 10 million tons a year will probably start within the next two years.

ASCE MEMBERSHIP AS OF MAY 8, 1953

Members	8,346
Associate Members	10,580
Junior Members	17,113
Affiliates	68
Honorary Members	40
Total	36,147
(May 9, 1952	34,643)

Proponents of the Seaway recently met in Washington under auspices of the Second Heartland Conference to invigorate the drive for the Seaway. Opposition to the project seems to be centering in the House Public Works Committee, whose chairman favors the project. Court action and other fireworks are prospects before this battle of giants is ended.

The Hells Canyon project for the development of the Snake River is another controversial issue with possibilities of repercussion against any solution adopted. Secretary McKay withdrew the Interior Department's objection to the construction of a power dam by the Idaho Power Co., stating that he was against the construction of the proposed government multi-purpose project at this site. The Federal Power Commission will begin hearings on the Idaho Power Co. application in July.

The private projects would be in operation sooner than the government projects and thus be of greater aid in relieving the existing power shortage in the Northwest. Another basic question involved was whether the proposed power development by the Federal Government would leave enough water for anticipated future irrigation needs.

Secretary McKay denies that this project is a "symbol in the fight between public and private power." He says that the FPC has ample authority to require an adequate development of the river. The Secretary has recently stated that "public power is here to stay" and that he has no intention of turning over government-built projects to private interests.

The U. S. Chamber of Commerce urged approval of H.R. 4877, which would authorize the Agriculture Department to help finance upstream soil and water conservation in cooperation with local government bodies. The Chamber states that levees and big dams are the traditional methods of flood control and it expresses the belief that more should be done by retarding the water near where the rain falls through soil erosion control practices and small check dams.

A recently introduced bill, H.R. 4788, would provide for joint federal-state financing of reclamation projects costing under $1,000,000 and involving under 5,000 acres.

Resources for the Future Conference

Former Ambassador Lewis Douglas has been named chairman of the Mid-Century Conference on Resources for the Future. The Conference has been scheduled to start December 2, 1953, following requests by many groups, including the ASCE Washington office, for a date later than May as originally scheduled. Vice-chairmen include the president of Rutgers, a former president of the U. S. Chamber of Commerce, and Dr. Compton, of M.I.T. The Conference will deal with the land and its products, water, minerals, energy, and related services. Though it will focus its attention on domestic problems, it must necessarily look at some world-wide situations. EJC participated in a recent meeting of the Council of Sponsors.

May 19, 1953

Student Chapters Sponsor Regional Spring Conferences

Midwest Conference

Representatives of the thirteen schools sending delegates to the Midwest Conference of Student Chapters, to which the University of Illinois at Navy Pier was host on May 1 and 2, presented papers in a competition that was a meeting highlight. The prizes, consisting of books donated by the Society, went to Robert MacDonald, of Navy Pier, who placed first; Dan Banks, of Purdue, second; and Roy Ostergren, of the University of Minnesota, third.

Culminating feature of the two-day program was a banquet, which was addressed by C. H. Mottier, vice-president and chief engineer of the Illinois Central Railroad. In an enthusiastically received talk, entitled "A Sound Philosophy of Life for an Engineer," Mr. Mottier said that the importance of being a good speaker and a good writer "cannot be overestimated" in the successful professional career. Equally important, he said, is selection of the first job after graduation. As a means of avoiding being a square peg in a round hole, he recommended that students conduct their own aptitude tests and select the job for which they feel they are best suited and one which they will enjoy.

Other speakers were George Salter, past-president of the Illinois Section; A. L. R. Sanders, Contact Member for the Navy Pier Chapter; and C. C. Caveny, dean of the Undergraduate Division of the University of Illinois at Chicago.

Warren Liebman, of the Navy Pier Branch, was Conference president. Officers for next year's Conference, to be held at the University of Wisconsin in Madison, are Charles Brylla, of the host Chapter, president; Richard Bielefeld, of Marquette, vice-president; and Jim Griffiths, of Northwestern, second vice-president. The other officers will be from the host Chapter.

Virginia Conference

An acute awareness of the dangers of specialization, with discussion looking toward improving the position of engineering as a profession, dominated the Virginia Conference of Student Chapters, to which the University of Virginia was host on April 29. The theme was developed in the address of welcome by Colgate W. Darden, Jr., president of the university and former governor of Virginia, who warned the student group against neglect of politics, government, and the arts, pointing out that engineers must maintain a place in society as well as in technology. Citing as a possible solution a liberal arts "pre-engineering" course, Mr. Darden said that such a course would not only reduce the danger of "over-technicalization," but also advance the engineering profession to a position comparable with the positions held by medicine and law.

Variations on the same theme were sounded by both luncheon speakers—James A. Rives, vice-president of the Virginia Section and member of the Virginia State Board of Examination and Certification of Professional Engineers, Architects, and Land Surveyors, and James A. Higgs, ASCE Director for District 10 and Contact Member of the Committee on Student Chapters. In a talk on registration, Mr. Rives emphasized the moral as well as the legal obligations of the practicing engineer, and urged wider acceptance and recognition of the Code of Ethics for legal as well as professional reasons. In his talk on the advantages of Junior membership in ASCE, Mr. Higgs reported that much thought was given to the subject of professional ethics at the recent Little Rock Conference on Student Chapters, Local Sections, and Junior Members.

Other Conference features included a panel discussion on Chapter affairs and the annual student paper contest. Winner in the contest was A. L. Crum, of the University of Virginia, whose paper on "Belfort Operations" dealt with the reconstruction of a tunnel dynamited by the Nazis during the war.

The attendance of about 80 included a number of members of the Virginia Section as well as representatives from the three engineering schools in the state—Virginia Military Institute, Virginia Polytechnic Institute, and the host Chapter.

New England Conference

Ten New England Chapters sent delegates to Northeastern University in Boston on Saturday, May 2, for the annual New England Conference of Student Chapters. Conference officers were John P. Morgan and Willis Esty, of the host Chapter, co-chairmen; Robert Chapman, of the M.I.T. Chapter, vice-chairman; and Virginia Landry, of the host Chapter, secretary-treasurer. Officers for the 1954 Conference will be elected later by the University of Rhode Island Chapter,

Winners in annual prize paper contest at New England Conference are (left to right) Harry Lit, first prize; Robert Marini, third prize; and Herbert Nickerson, second prize.

Photographed at highly successful Conference of Virginia Chapters, held at University of Virginia on April 29, are (front row, usual order) Col. Herman Orr, Corps of Engineers; unidentified Virginia Section member; T. E. Shelburne, vice-president of Virginia Section; James A. Higgs, Director of ASCE and luncheon speaker; R. E. L. Gildea, Faculty Adviser for University of Virginia; Howard Newlon, Jr., president of host Chapter; John W. Roberts, Virginia Section president; James A. Rives, Section vice-president and speaker; Prof. E. R. Estes, University of Virginia; and Prof. H. L. Kinnier, University of Virginia. Students in second and third rows are from VPI and students at the rear represent University of Virginia, with the exception of the cadets who are from VMI. Others in civilian dress are Section members.

Pictured at head table at Mid-Continent Conference of Chapters banquet on May 7 are (left to right) Prof. G. W. Bradshaw, chairman, department of civil engineering, University of Kansas; Prof. Horace W. Wood, Faculty Adviser, University of Missouri Student Chapter; F. M. Dawson, Director of ASCE and dean of the College of Engineering, State University of Iowa; Stan Scruby, University of Missouri, Conference secretary-treasurer; Norman Scott, University of Nebraska, Conference vice-president; Prof. Harry Rubey, chairman, Department of Civil Engineering, University of Missouri; and H. O. Croft, dean, College of Engineering, University of Missouri. Empty chair was for Darrell Hobson, Oklahoma Institute of Technology, Conference president.

which was selected as host Chapter. A three-year Conference program, set at the meeting and approved by representatives of the colleges attending, scheduled the University of Massachusetts as host to the 1955 Conference and M.I.T. to the 1956 Conference.

Symposiums covering two major fields of engineering were presented as a vocational aid. Group leader of discussion on "Engineers in the Construction Field" was John A. Volpe, Massachusetts Commissioner of Public Works and President of the John A. Volpe Construction Co. Study of the consulting field was covered by Thomas R. Camp, of the Boston firm of Camp, Dresser & McKee. The speaker at the dinner meeting that concluded the program was Robert M. Edgar, vice-president of the Boston & Maine Railway, who discussed the St. Lawrence Seaway Project.

Winning students in the annual prize paper competition were Harry Lit, of the University of Massachusetts, who received first price of $20 and Junior membership in the Society; H. Nickerson, of Tufts, who won second prize, consisting of $10 and Junior membership; and Robert Marini, of Northeastern University, who was awarded third prize of Junior membership.

Mid-Continent Conference

A varied program was presented at the Ninth Annual Mid-Continent Conference of Student Chapters, held in the University of Missouri Memorial Student Union, May 7, 8, and 9. For the first time in four years representatives from all the member Chapters were present at the Conference, with 65 delegates attending from the University of Arkansas, the University of Kansas, Kansas State College, the University of Missouri, Missouri School of Mines, the University of Nebraska, the University of Oklahoma, Oklahoma Institute of Technology, and Washington University (St. Louis).

Speakers on the three-day program included: F. M. Dawson, ASCE Director and dean of the College of Engineering, State University of Iowa; Prof. G. W. Bradshaw, vice-chairman, Committee on Student Chapters, and chairman, Department of Civil Engineering, University of Kansas; Prof. Harry Rubey, chairman, Department of Civil Engineering, University of Missouri; Leo Hill, city manager, Columbia, Mo.; and Dr. Fred McKinney, chairman, Department of Psychology, University of Missouri. A representative from each of five member Chapters presented a technical paper in the student paper contest, and the winning paper was given by Frank Diekneite, of the University of Missouri. His subject was "Stress Analysis of Indeterminate Structures Using Models."

Retiring Conference officers are: Darrell Hobson, Oklahoma Institute of Technology, president; Norman Scott, University of Nebraska, vice-president; and Stan Scruby, University of Missouri, secretary-treasurer. The newly elected officers are A. C. Little, University of Oklahoma, president; Jerry Friesen, Kansas State College, vice-president; and Bill Luckfield, University of Kansas, secretary-treasurer. In accordance with Conference tradition, next year's Conference will be held at the school of the secretary-treasurer, the University of Kansas.

Upstate New York Conference

A student paper competition was a major feature of the Upstate New York Conference of Student Chapters, held at Cornell University on April 17 and 18. Winners in the contest, which produced a varied and interesting group of papers, were Richard N. Wright, of Syracuse University, first prize, for a paper entitled "Citizen Civil Engineer"; Sander Wise and James M. Symonds, of Cornell University, second prize, for their paper on "The Builders S-J Flow Nozzle"; and Richard W. Wolfley, of Clarkson College, third prize, for a paper on "How to Plan for and Finance Our Highways."

A. S. Wikstrom, of A. S. Wikstrom, Inc., heavy construction contractors with a sizable amount of work in progress on the New York State Thruway, gave an illustrated lecture on the Thruway construction. The other featured speakers were ASCE Director A. A. K. Booth, who discussed Society history and operation, and Robert H. Dodds, chairman of the ASCE Committee on Student Chapters, who spoke on the value of the Student Chapter Conferences as a means of facilitating the free exchange of ideas among engineers.

Maryland-District of Columbia Conference

The rugged terrain of Rocky Gorge Dam in Howard County, Maryland, was the scene of an inspection trip that featured the twelfth annual Maryland-District of Columbia Regional Conference on April 25. Arrangements for the trip, described as "superb" by the delegates from the five participating Chapters, were made through the courtesy of John J. Downey, senior designing engineer for the Washington Suburban Sanitary Commission. Two other engineers—Rudolph Aldrovandi and Gustav Diezman, representatives of the Ambursen Engineering Corp., New York—were "on-the-spot" hosts to the group and answered questions as they came up.

Mr. Downey provided background information on the $2,500,000 project, which is being built on the Patuxent River $2^1/_2$ miles northwest of Laurel, Md. Designed primarily to meet the water needs of suburban Maryland, the dam will impound 6,500,000,000 gal of water. Construction is now more than half completed. A visit to the engineer's office for an explanation of the blueprints behind the work completed the day.

Howard University was Conference host to Chapters from the University of Maryland, George Washington University, Johns Hopkins University, and the Catholic University of America. Kenneth E. den Outer, president of the Catholic University of America Chapter,

wrote an article on the Rocky Gorge Dam from which facts mentioned here are taken.

Students from five Chapters in Maryland-District of Columbia Sections inspect Rocky Gorge Dam construction site on trip that highlighted the group's twelfth Regional Conference.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

ASCE operation at national level was the topic of a talk given by G. Brooks Earnest, Vice-President of ASCE and new president of Fenn College, at the April meeting of the **Akron Section.** In a discussion of collective bargaining following his talk, members suggested getting all graduate engineers into the Society and giving them a sense of professional awareness as a bulwark against the growth of unionism.

A proposed water supply system for Fairbanks was discussed at the April 30 meeting of the **Fairbanks Subsection** of the **Alaska Section** by H. C. Westfall, of Beck & Associates. To prevent freezing, a circulating type of system will probably be used instead of placing the lines in the extremely expensive utilidors that have customarily been used in Alaska. It will be the first large installation of the kind in the Territory. At the April meeting of the **Anchorage Subsection,** Oliver V. Kola was elected vice-president to fill the vacancy caused by the departure of Vice-President Stanley from the Territory. In a talk on "Atomic Energy and Radiological Warfare," Wesley H. Butler, civil engineer for the Alaska District of the Corps of Engineers, outlined the possibilities and limitations of atomic and radiological warfare and debunked some of the popular "scare stories."

As the principal feature of its two-day summer meeting, the **Alabama Section** invited the engineers of the state to join in an all-day inspection of the Southern Railroad's $12,000,000 ultra-modern Ernest Norris Freight Yard and shop facilities near Birmingham, as guests of J. B. Akers, M. ASCE, chief engineer of the system. A special train took the party of 400, which included members of six other engineering societies, to the project on May 15. A barbecue luncheon was enjoyed prior to the trip about the yard. On May 16 Mr. Akers and H. C. Mauney, vice-president of the New Orleans and Northeastern Railroad, expanded on operation and maintenance problems of a railroad system now converted to diesel-powered locomotives. Section President Melvin R. Williams and ASCE Director James A. Higgs were speakers at a business meeting, during which the Section laid plans for the formation of Subsections in Birmingham and Mobile.

The spotlight was on highways at the spring meeting of the **Arizona Section** and the University of Arizona Student Chapter held at Tucson, May 2. A program of student papers in the morning session—by Joseph Crossette, J. H. Trammell, and T. S. Royden—dealt with the need for highway expansion, economic aspects, and current design trends. The financial needs of the Arizona State Highway System were analyzed, in a leading paper presented during the afternoon, by W. E. Willey, Highway Department engineer in the Division of Economics and Statistics. Other speakers were Warren Hunter, chief engineer for the Fisher Contracting Co., Phoenix, who presented the contractor's viewpoint on "Stretching the Highway Dollar," and G. L. McLane, former district engineer for the Bureau of Public Roads at Phoenix, whose subject was "Highway Engineering."

In a talk on "Civil Engineering," presented at the April 21 luncheon meeting of the **Buffalo Section,** Dean Paul E. Mohn, of the University of Buffalo School of Engineering, discussed the demands being placed on engineers at the present time and engineering education aspects of the situation, with special reference to his own engineering school.

Members of the **Cincinnati Section** were shown the multiple uses of steel in highway construction in a Bethlehem Steel Co. film that featured the technical program at their April 1 meeting. Bart Shapleigh, local contracts manager for the company, was on hand to answer questions.

In a talk slanted at the younger engineers, Trygve Hoff, consulting engineer of Cleveland, discussed "Bridge Failures from a Design and Maintenance Viewpoint" at the April 17 meeting of the **Cleveland Section.** Stating that 90 percent of all bridge failures are due to failures in detail or secondary effects and citing the failure of the Quebec Bridge across the St. Lawrence with its tragic loss of life as a case in point, Mr. Hoff urged his young hearers to get all possible experience in detailing and design. He suggested that they study their specifications, which are meant to serve as a guide and not as something to be followed blindly.

The **Connecticut Section** entertained the Yale civil engineering seniors at its April meeting, held in New Haven, and the University of Connecticut seniors at its May meeting, in Hartford. Presentation of prizes to outstanding seniors was a major feature of both programs. The Yale winners were Peter L. Bottone and Anthony J. Panico, and the University of Connecticut winners, Stuart M. Benson and James W. Connor. ASCE Director Frank A. Marston addressed the May meeting on Society organization and operation, and discussed future plans as they affect activities at Local Section level.

The Board of Engineers for Rivers and Harbors was discussed by Brig. Gen. Bernard L. Robinson, of the Corps of Engineers, at the April meeting of the **District of Columbia Section,** and Donald D. Allen, staff member of the Board, spoke on "Ports of the United States." Members of the Junior Forum heard Archie N. Carter, of the Associated General Contractors of America, speak at their April meeting on the subject, "Better Highways Are Being Built—How to Get More of Them." Mr. Carter showed slides of major highway projects throughout the country.

Foundation problems encountered on construction of the Savannah River plant of the Atomic Energy Commission were described at the April meeting of the **Central Savannah River Subsection** of the **Georgia Section** by O. K. Albright, staff member of the Engineering and Construction Division of the Savannah River Operations Office.

The **Illinois Section** is participating in a joint effort of the Chicago engineering societies to get an educational television station for the city. Functioning through a General Education Committee, the engineers are endorsing and supporting a Chicago Education Television Association which is being formed to finance the undertaking. Section member E. Montford Fucik is chairman of the General Education Committee.

ASCE activities at national level were outlined by ASCE Executive Secretary William N. Carey, at the April 14 luncheon meeting of the **Kansas City Section.** His talk included a discussion of such new poli-

cies as the publication of Proceedings by photo-offset and some of the financial problems involved in Society operation.

Emil H. Praeger has been chosen "Metropolitan Engineer of the Year" by the **Metropolitan Section** for its first award for "exceptional service to the civil engineering profession in the metropolitan area." Mr. Praeger won the newly established citation for his concept and design of Hudson River Pier 57. In World War II he designed a breakwater for use in the invasion of Normandy, and he was consulting engineer on renovation of the White House. Mr. Praeger received the award at the Section's annual meeting in May. New Section officers, elected during the meeting, are John P. Riley, president; P. C. Rutledge, vice-president; and William J. Shea, treasurer. Frank C. Mirgain remains as secretary. The Junior Branch of the Section has elected the following new officers: V. A. Smoots, president; Joel E. Fisher, Jr., first vice-president; Eugene Jones, second vice-president; Joseph Ward, secretary; and Eugene L. Fieldhammer, treasurer. The elections took place at the group's May dinner meeting, at which Roger Gilman, of the Port of New York Authority, was featured speaker.

Emil H. Praeger

Speaking and writing contests for Junior and Student Chapter members in the area have been featured at recent meetings of the **Kentucky Section.** At the March meeting six students from the Chapters at the University of Kentucky and the University of Louisville presented technical papers in the Section's annual student competition. The awards, consisting of Junior Membership in ASCE, went to James E. Humphrey, of the University of Kentucky, and B. N. Callihan, of the University of Louisville. "ASCE—My Observations of the Society" was the topic on which four Junior Members spoke at the April meeting in a screening competition to pick candidates for the District 9 Council's competition for the newly established Daniel V. Terrell Award. John E. Heer, Jr., was chosen to represent the Section in the final competition at the spring meeting of the District 9 Council.

Education was the featured subject at the **Maine Section's** annual spring conference held at the University of Maine, Orono, on May 9. Students, young engineers, older engineers, educators, and employers took part on equal footing in the unusual all-day discussion that "went a long way towards creating a better understanding of the problems involved in educating young engineers." Varied opinion was brought out in the employer group as to just what the civil engineering curriculum should cover. There was some disagreement in the profession, too, as to just what can be accomplished in the four-year curriculum. At the dinner meeting that concluded the program, Ashley S. Campbell, dean of engineering at the University of Maine, summarized the day's activities, and pointed out how the many suggestions made during the day could or could not be fitted into an education program. The morning session was conducted entirely by students—John C. Bridge, George H. DesRoberts, Glenn E. Edgerly, Robert Greenough, Harold B. Hutchinson, and James D. Murtha.

The **Montana Section** has dissolved its Hungry Horse Branch, which was formed in January 1950 for the convenience of Section members engaged on the Hungry Horse Dam, now nearing completion. At its last meeting in April the group voted to disband and requested the Section to authorize its step. The program for the occasion consisted of the showing of several films depicting topographic surveying by photogrammetric methods.

ASCE Director J. A. Higgs discussed Student Chapter activities at the **North Carolina Section's** all-day spring meeting held at North Carolina State College in Raleigh on May 1. Other program features were an illustrated talk on ruins in Southern Rhodesia, given by Dr. Willard E. Berry, chairman of the Duke University geology department, and presentation of two student papers with William C. Wilson, of North Carolina State, the winner of a Section award for his paper on "Unionism." Six seniors received awards of one-year paid-up membership in ASCE. They were Jack C. Coss, Glenn A. Eason, Gene W. Johnson, and Donald H. Kline, of North Carolina State and Ralph R. Rumer and Robert F. Pierry, of Duke. One of the awards was the gift of Ben O. Hood, of Charlotte. Also honored were two outstanding seniors in the construction course at North Carolina State—John M. Gilkey, of Raleigh, and J. H. Jones, of Charlotte—who received AGC awards of $50 and $25, respectively.

Students from engineering schools in North and South Dakota and the University of Minnesota were guests of the **Northwestern Section** at its May meeting. Three students from the University of Minnesota and one from each of the Dakota schools, were awarded the annual Section prizes. Featured speaker was Roy Dunlap, columnist for a St. Paul paper, who related his experiences on a recent tour of South America and showed colored slides made on the trip.

Structural factors of interest in the 1952 California earthquakes were discussed at the April meeting of the **Oregon Section** by Karl Steinbrugge, structural engineer for the Pacific Fire Rating Bureau. By means of colored slides taken after the disaster, Mr. Steinbrugge showed some of the factors involved in lateral force design and emphasized the need for qualified inspection during construction by pointing to several structures that definitely showed poor workmanship.

The May meeting of the **Central Pennsylvania Subsection** of the **Philadelphia Section,** which marked the group's first anniversary, was the occasion for installation of new officers; talks by ASCE Director Francis S. Friel and Don P. Reynolds, Assistant to the Secretary of ASCE; and showing of the "Adam to Atom" film. New Section officers are Samuel I. Zack, president; C. Radford Berry, vice-president; and Floyd Nelson, secretary-treasurer.

At a recent joint meeting of the **Pittsburgh Section** and the Civil Section of the Engineers Society of Western Pennsylvania,

Purdue University is host to All-Indiana Student Chapter and Section Banquet, attended by members from Chapters at Notre Dame, Rose Polytechnic, and Purdue and by 150 members of the Indiana Section. Shown here (front row, usual order) are Clyde E. Williams, president, Indiana Section; Edward Moulton, president, Purdue University Chapter; Richard Butler, Edward Pinilla, James Melton, and Daniel Banks, of Purdue; Edward J. Powell, Notre Dame; Frank McClure, Purdue master of ceremonies; and W. A. Nashert, Jr., president, Notre Dame Student Chapter. Second row shows A. A. Potter, dean of engineering at Purdue; ASCE Vice-President G. Brooks Earnest, president of Fenn College and speaker of the evening; James A. McCarthy, Notre Dame Faculty Adviser; B. B. Lewis, Purdue Faculty Adviser; Warren W. Parks, ASCE Director, District 9; R. B. Wiley, head, Purdue Civil Engineering School; W. L. Shilts, head, Notre Dame Civil Engineering School; and Edward A. MacLean, head, Rose Polytechnic Institute Civil Engineering School. Professor Earnest's featured address, entitled "Are All the Frontiers Conquered?" was received with much enthusiasm.

The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Second Annual Report to Surveyors

It has been a year now since our first report to you on the progress of "The Surveyor's Notebook."

In the past twelve months these "unusual surveying problems and their solutions" have helped an ever-growing number of engineers and surveyors to use their instruments with greater pleasure and profit. And the page has developed into a professional forum for exchange of useful information—and, sometimes, a discussion of controversial techniques.

Jack Goggin, Marathon, Fla.

Thousands of copies of the collected articles from the first year's series have gone out to surveyors who asked for them. In fact, requests from field men were so numerous that a third printing is nearly exhausted.

And now we are pleased to announce that the second year's stories and tips from "The Surveyor's Notebook" have been gathered together and reprinted in permanent form.

Tractor and Level Whip Mud Flats

The problems and "tricks of the trade" in Series 2 are new. George Gabus of New York City's Board of Water Supply, for instance, tells you his method of eliminating errors in precise alignment. A Cleburne, Texas, surveyor relates what can be done about weather conditions hampering every man in the field.

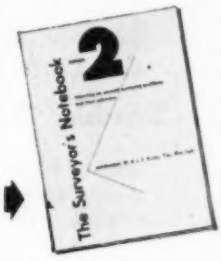
On one page, Chicago's George Salter shows how to subdivide 50,000 acres into nearly 200 lots in accordance with the rights of 600 people. On another, Maryland's Wesson Cook gives his method for bringing in stations in the muck of the Red River Valley.

Surveying the Antarctic

The Virginian Railway Company's Henry Stanley will cause a great deal of comment, we are sure, with his use of the gradienter in rough terrain; and G. W. Herzog of Shell Oil Company may surprise you with his use of a level on a tractor for whipping mud flats.

"A Bit More Mauka, a Few Feet Makai" describes how Prof. Russell Brinker of VPI solved unique problems in tracing old land deeds in Hawaii. And Comdr. Richard Black recounts his adventures while surveying the Antarctic.

John Goggin's method of determining in the field, without calculation, whether or not a survey closes will solve many a headache, as will S. E. Huey's page on getting more out of your compass. And a New Hampshire forester and land surveyor, Gerald Hyde, even tells how a surveyor can add new business with alignment jobs *inside* industrial plants.



We will be glad to send you a free copy of this new "Surveyor's Notebook." Just write for Series 2.

New Series

When you write for your bound copy of "The Surveyor's Notebook"—Series 2, ask also for the new Bulletin 50. It gives full details on Gurley instruments.

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Head table at recent joint meeting of Northeastern Section and Boston Society of Civil Engineers shows (left to right), Prof. J. B. Wilbur, vice-president of Section; Section President Howard M. Turner; Dr. Rolf Eliassen and James C. Lamb, III, speakers; and J. Stuart Crandall, president, Boston Society of Civil Engineers. Messrs. Eliassen and Lamb spoke on "Use of Radioactive Tracers in Civil and Sanitary Engineering," including such applications as controlling corrosion in pipeline networks.

G. W. Patterson, assistant chief engineer for the Pennsylvania Railroad, Central Region, described the company's Conway Yard development. Rear Admiral Joseph F. Jelley, chief of the Bureau of Yards and Docks, addressed another large joint meeting of the Section, the ESWP, and local groups of the Pennsylvania Society of Professional Engineers, the Military Order of the World Wars and Naval Reserve, and Civil Engineer Company 4-3.

Cement—from its chemical composition to techniques for achieving watertightness when used in the construction of concrete vessels—was the topic of discussion at the April 9 meeting of the **Providence Section.** The featured speaker represented the Sika Chemical Corp., of Passaic, N.J.

Recent speakers at **Sacramento** luncheon meetings have included Leland Graham, regional counsel for the Bureau of Reclamation, who discussed "A Lawyer's Function in the Point IV Program in the Middle East"; J. Carl Jennings, vice-president of the Section and assistant city engineer of Sacramento, who described the city's $3,700,000 sewage treatment plant now under construction; and Marshall Jones, who discussed the Trinity River Division of the Central Valley Project.

Charles A. Smith, Jr., is now treasurer of the **San Diego Section,** filling the vacancy caused by the resignation of Harlow Hyde. At the March meeting ASCE Director M. J. Shelton outlined discussion on a possible dues increase that took place at the San Francisco Convention, and commented on possible benefits from such an increase.

Syracuse Section officers for the coming year will be Clyde A. Coats, president; Robert B. B. Moorman, first vice-president; Conrad W. O'Connell, second vice-president; and Charles M. Antoni, secretary-treasurer. Featured speaker at a recent meeting with the Technology Club of Syracuse was Dr. Harry A. Curtis, director of the TVA, who described the system.

The forthcoming Washington highway program, as determined by 1953 legislative action, was outlined by W. A. Buggee, director of highways for the state, at the April meeting of the **Tacoma Section.**

Coming Events

Los Angeles—Annual field day meeting at the Oakmont Club, Glendale, Calif., on June 23, from 12:30 p.m. to 10 p.m. Reservations are required for dinner which will be preceded by a series of sports events during the afternoon. Call Chuck Gorham at MI. 4211, extension 456, for the location of Friday luncheons of the Junior Forum. The Sanitary Group is taking a field trip to the Acme Brewery, June 26, at 3:30 p.m.

New England Council—The newly formed New England Council will meet at the Faculty Club of the Massachusetts Institute of Technology on June 22, at 5 p.m.

Philadelphia—Meeting at the Engineers' Club, June 9, at 7:30 p.m., preceded by dinner at the Club.

Sacramento—Weekly luncheons every Tuesday at the Elks Temple, Sacramento, at 12 noon.

San Francisco—Dinner meeting at the Engineers' Club of San Francisco, June 16, at 6 p.m.

Scheduled ASCE Conventions

MIAMI BEACH CONVENTION
Casablanca Hotel
June 17–19,
1953

NEW YORK CONVENTION
Hotel Statler
October 19–23,
1953

ATLANTA CONVENTION
Hotel Biltmore
February 15–19, 1954

How to Uncover Scholarship Information

In response to many requests for information about scholarships available to young men interested in careers in engineering and science, the Engineering Manpower Commission of Engineers Joint Council has suggested several sources of possible information. Probably the best sources, it indicates, are the engineering schools themselves. Inquiry from the schools will be facilitated by the list of institutions with curricula accredited by the Engineers Council for Professional Development. The listing is available from ECPD at 29 West 39th Street, New York 18, N.Y., at 25 cents a copy.

The following publications are also suggested by the EMC: *Scholarships and Fellowships Available at Institutions of Higher Learning*, Bulletin No. 16, U.S. Office of Education, 1951, which may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.; *Scholarships, Fellowships and Loans*, by Norman S. Feingold, Bellman Publishing Company, 1951; and *Complete Guide to American Colleges and Universities*, C. E. Lovejoy, Simon and Schuster, New York, 1948.

Monograph in Alloys of Iron Research Series Ready

Results of world-wide researches into the effects of adding various metals to iron and steel are now being readied for publication by Alloys of Iron Research. Sponsored by the Engineering Foundation, the new Monograph Series will appear under the imprint of John Wiley and Sons, Inc. The major role of aluminum in modern ferrous metallurgy makes the first book in the series—*Aluminum in Iron and Steel* by S. L. Case and K. R. Van Horn—particularly timely. It will be released in June.

Four more volumes in the series, to be published about six months apart, are already in preparation. They will cover the effects on iron and steel of: (1) Nickel, (2) manganese, (3) titanium, and (4) columbium, zirconium, boron, tantalum, and calcium. Inquiries should be addressed to Alloys of Iron Research of the Engineering Foundation, 29 West 39th Street, New York 18, N.Y.

PEDESTRIAN BRIDGE for Mt. Carmel High School, Lawson, Kentucky. This is one of the smallest suspension bridges designed and fabricated by American Bridge in many years. Structure was erected by the faculty and students of the school.

Study in Extremes
by
AMERICAN BRIDGE

SAN FRANCISCO-OAKLAND BAY BRIDGE fabricated and erected by American Bridge is the world's greatest. It is 8½ miles between terminals of which 4½ miles is steel superstructure over San Francisco Bay.

MOST people associate American Bridge with *big* bridges. And that's understandable, for they're the ones that make the headlines.

But, American Bridge also builds small bridges. In fact, we have recently designed and fabricated a part of an exceptionally small suspension bridge. We show it here. And to give you a better idea of the wide variety of our work, we also show a picture of the famous San Francisco-Oakland Bay bridge, the world's greatest bridge.

What a study in extremes! The little pedestrian bridge is only 402′ 7½″ long and 6′ wide, while the main structure for the tremendous San Francisco-Oakland Bay bridge is 22,720′ long. It has two main suspension spans, each 2,310′ long. The main span of the tiny foot bridge measures but 244′ 7½″! The total weight of the smaller structure is approximately 25 tons; steel for the larger job weighs 201,000 tons!

Contrasting these two bridges is just another way of saying that no bridge is too large or too small for American Bridge. We have the fabricating facilities, erecting equipment and technically trained personnel to handle any type of steel construction with exacting precision, thoroughness and speed . . . any time, anywhere. For detailed information regarding your requirements, call our nearest office.

Interesting Movie Now Available for FREE Showing

The new sound and color motion picture—*Building for the Nations*—a candid, factual photographic record of the highlights of the fabrication and erection of the United Nations Secretariat Building in New York is now available for free showing in churches, schools, clubs and industries. For bookings, write Pittsburgh office.

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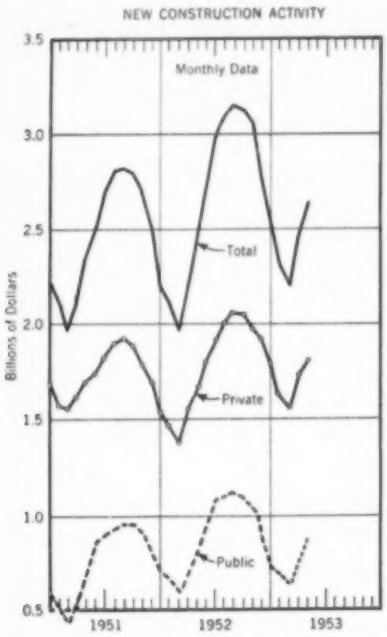
NEWS BRIEFS . . .

April Construction Activity Up 8 Percent from March

Expenditures for new construction in April increased 8 percent to a total of $2.6 billion—5 percent above the April 1952 total—according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics and the Building Materials



April construction expenditures, rising 8 percent in April to $2.6 billion, are indicated in Department of Commerce curves.

Division of the U.S. Department of Commerce. Private outlays of $1,801 million for the month represented an increase of 5 percent from March, mainly as a result of the rise in residential and public utility construction. Seasonal gains in road-building during April and increased public spending for industrial plants, including atomic energy facilities, accounted for most of a 14 percent rise in new public construction to a total of $837 million.

The value of new work done on private non-farm building during the month amounted to $887 million—some 6 percent above the March total and 4 percent more than the April 1952 figure. Although private industrial building for the month was slightly below the March figure, and there were indications of some further tapering of expenditures on this work, outlays remained close to last year's record level. Expenditures for commercial construction and most other types of private non-residential building remained at about the March level during the month and, with the exception of hospital construction, were considerably above April 1952 outlays. Private expenditures for new work on public utilities, especially electric power and gas facilities, continued the uptrend that began in March.

Military and naval expenditures for new construction showed a less than seasonal rise during the month, while public outlays for hospitals and schools remained at the March level. Among other types of public non-residential building, monthly expenditures for construction of penal and corrective institutions thus far in 1953 have been running at double last year's rate. April 1953 outlays of $185 million for new work on highways are attributed largely to expenditures by state and local governments.

State and local funds accounted for about 55 percent of total public expenditures for new construction during 1952 and thus far in 1953, compared with 62 percent in 1951 and about 70 percent in 1949 and 1950, the joint agencies note. These funds went, principally, for highways, schools, hospitals, and sewer and water facilities.

In the first four months of 1953, new construction with a total value of more than $9.6 billion was put in place, compared with $9.1 billion in the corresponding period of 1952—an increase of 6 percent. Total private outlays, amounting to $6.7 billion, were 7 percent above expenditures for the corresponding period a year ago, while public expenditures of $2.9 billion were only 3 percent higher.

AWWA Initiates Transmission and Distribution Division

Water works men from all over the country gathered in Grand Rapids, Mich., May 10–15 for the 73rd annual conference of the American Water Works Association and brought themselves up to date on the methods, materials and equipment of their field. Newly added to AWWA activities is a Transmission and Distribution Division, which held its first session at the meeting. The first study taken up by the division was the new ASA Standard for Cast-Iron Pipe.

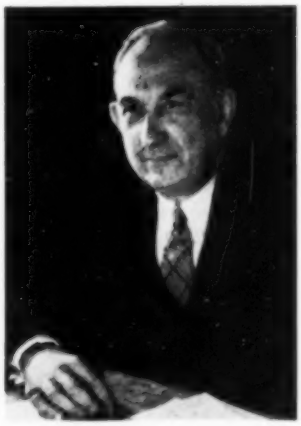
During the week-long meeting honorary membership in the AWWA was awarded to Wendell R. LaDue, M. ASCE, chief engineer and superintendent of the Akron (Ohio) Bureau of Water and Sewerage, and Reeves Newsom, M. ASCE, village manager of Scarsdale, N.Y.

Taking office at the meeting was Morrison B. Cunningham, superintendent and engineer of the Oklahoma City Water Department as president, and Dale Maffitt, general manager of the Board of Water Works Trustees, Des Moines, Iowa, as vice-president.

Past-President Dougherty Elected Head of the Moles

Richard E. Dougherty, Past-President of ASCE and consultant with the New York firm of Seelye, Stevenson, Value, and Knecht, was elected president of the Moles, New York Society of heavy construction men, at the organization's annual meeting in New York on May 6. Mr. Dougherty was with the New York Central System from 1902 to 1951, retiring as active vice-president of the system in 1948 and from an advisory role with it in 1951.

Other new Moles' officers elected were George F. Ferris, M. ASCE, of the Raymond Concrete Pile Co., first vice-president; William A. Durkin, of the Walsh Construction Co., second vice-president; Theodore M. Avery, of the Blaw-Knox Co., sergeant-at-arms; Harry T. Immerman, M. ASCE, of Spencer, White and Prentis, Inc., secretary; and Edward G. Johnson, of the Arthur A. Johnson Corp., treasurer.



Richard E. Dougherty

New Air Terminal Will Open at Newark Airport

With completion of an $8,500,000 passenger terminal at Newark Airport scheduled for July 1, the facilities and services of the airport will be greatly expanded. At present the airport is operating at only 70 percent of the load that prevailed before February 1952 when the field was closed following several crashes in the vicinity. Modified operation of the airport was resumed in November.

The first air terminal structure to be designed and constructed by the Port of New York Authority, the main building and arcades will have an area of about 188,400 sq ft—five times the size of the present passenger terminal. It is laid out like a shopping center, with 15 air-conditioned retail shops on one side of the 500-ft-long main concourse and space for ticket counters on the other side. The building will also have many service facilities not usually found at airport terminals, including a luxury restaurant and cocktail bar, a bank, and a general apparel store. There will be such special features as a sky-blue ceiling with sunken lights to give the illusion of the out of doors, and a glass-enclosed observation deck on the mezzanine level.

Other recent improvements for passenger comfort and convenience include concrete taxiways with built-in "humps" to expedite drainage in bad weather, and special roadways to keep passengers and baggage separated. In November a new $9,000,000 instrument runway was put into service.

The new terminal will make the Newark field "rank with the finest in the world," according to John M. Kyle, chief engineer for the Port of New York Authority. He said that the Authority has spent $26,000,000 for improvements since it took over the field five years ago.

Men and Machines Clean Up Tornado Damage

Civilians and the Army Air Force, bolstered by heavy equipment, begin the gigantic task of removing debris and repairing damage at Waco, Tex., hard hit by the tornado of May 11. Wide World Photo.

More Firms Added to Nuclear Power Study

The Atomic Energy Commission has approved the addition of twelve companies as associates in a joint study it is conducting, with the Dow Chemical Co. and the Detroit Edison Co., of the possibility of developing a nuclear reactor to produce power. Though the Dow-Detroit Edison companies will continue to be the primary participants in the joint study, they will be aided by qualified personnel from the twelve additional companies as well as from other companies already associated with them, as the project requires.

The twelve additional companies are the Consolidated Gas Electric Light and Power Company of Baltimore; the Hartford Electric Light Co.; the Niagara Mohawk Power Corp.; the Potomac Electric Power Co.; the Rochester Gas & Electric Corp.; the Southern Co.; the Allis-Chalmers Manufacturing Co.; the Bendix Aviation Corp.; the Ford Motor Co.; United Engineers and Constructors, Inc.; the Atlantic City Electric Co.; and Gibbs & Cox, Inc.

Dow Chemical and Detroit Edison comprise one of the original study groups brought into the atomic energy program in 1951 to study the practicability of private investment in the nuclear power field. The three other original study groups are the Commonwealth Edison Co., and the Public Service Company of Northern Illinois, of Chicago; the Monsanto Chemical Co. and its associate, the Union Electric Company of Missouri, both of St. Louis; and the Pacific Gas and Electric Co. and the Bechtel Corp., of San Francisco. Reports from these companies are already under examination by the AEC. A fifth group, consisting of the Foster Wheeler Corp. and the Pioneer Service & Engineering Co., was recently authorized.

Los Angeles Authorizes Monorail Transit Survey

As a first step toward solving the Los Angeles transit problem, the Los Angeles Metropolitan Transit Authority has signed an $85,000 contract with the New York engineering firm of Coverdale & Colpitts to conduct a preliminary engineering and economic survey to determine the feasibility of a monorail. Two other engineering firms—Gibbs & Hill, of New York, and Donald Baker, of Los Angeles—will participate in the survey, which will require about eight months. The three firms, working on different portions of the survey, are to determine if the proposed monorail plan (September 1951 issue, page 71) is the solution to the traffic problem or if another transit system would be better.

The Authority, which was created in 1951 to construct and operate a mass rapid transit system from the San Fernando Valley through Los Angeles to Long Beach with feeder bus lines, is headed by Martin Pollard as chairman and Ralph Merritt as general manager.

Contract Given for Turnpike Extension

A $5,336,093.67 contract for construction of the fourth project on the Delaware River Turnpike Extension has been awarded to C. J. Langenfelder & Sons, Inc., Baltimore, Md., according to an announcement from T. J. Evans, chairman of the Pennsylvania Turnpike Commission. The contract includes two sections of the superhighway in Whitemarsh and Plymouth townships, Montgomery County, a combined distance of 6.11 miles.

The unofficial low bidder for the fifth project, involving two sections of the extension in Montgomery and Bucks counties, is James D. Morrissey, Inc., with a bid of $5,385,322.10.

Work on the first four projects and on the substructure of the Schuylkill River bridge has been started. The latter contract was awarded to Buckley & Company, of Philadelphia, at their price of $494,085.66.

Electro-Osmotic Process Stabilizes Power Plant Foundation

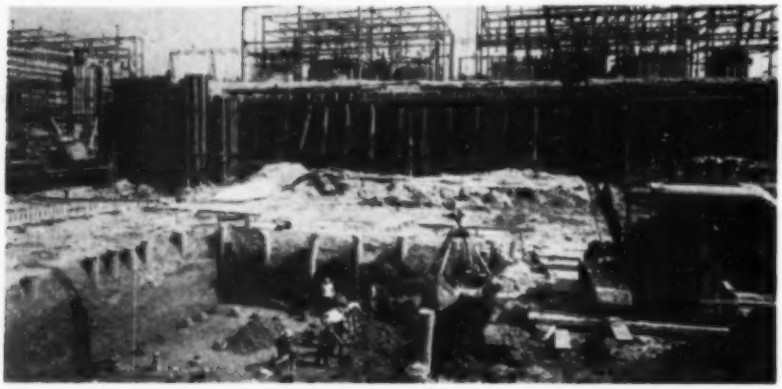
The problem of the stabilization of silty soils, long a headache to engineers and contractors alike, has been surmounted uniquely and effectively in the foundation excavation for the Weadock Power Plant of the Consumers Power Company, at Essexville, Mich. Using the long-neglected principle that a fluid in a capillary will flow from a positive to a negative electrode, Dr. Leo Casagrande, M. ASCE, has developed a system which will remove water from and increase the shear stress of silty soil. The system is simple involving only the insertion of metal anodes and cathodes into the soil and some source of power to provide the voltage gradient. The cathodes are hollow so as to carry the water out of the soil. The electrodes at the Weadock project were placed 15 ft apart. The differential between points was 90 v.

The situation at the Weadock Power Plant was complicated by the presence of a substation and underground power ducts adjacent to the east side of the excavation, other units of the power station adjacent to the north, and the Saginaw River adjacent to the site on the west. The deepest excavation, which was 37 ft below the river level, was for a new intake. Steel sheeting was placed on the west, north and east faces of the excavation.

The first cut of the foundation, to El. 565 in medium sand, was made without difficulty by dewatering by wellpoints and sheeting the excavation. Upon starting the second cut, which was in a silty sand stratum, the steel sheeting on the east embankment began to shift into the pit, endangering the substation and underground ducts in that area. The excavation had to be backfilled to El. 565.

An electro-osmotic system was then installed, and excavation in the silt stratum was completed to El. 556 and to El. 546 at the intake site. The effect of this system was to stop all lateral movement of the east sheeting and to stabilize the embankment in the intake excavation area, as shown in the photo.

The stabilizing was done by the Wellpoint Dewatering Corp., of New York, under the supervision of Richard W. Loughney, J. M. ASCE.



Excavation in silty-fine sand stratum for intake of Weadock Power Plant at Essexville, Mich., is stabilized by electro-osmosis (above). Shifting of steel sheeting along east embankment, shown in background, was stopped by system of electrodes along embankment. Excavation for north discharge was also stabilized by electro-osmosis (top photo). Electrodes can be seen projecting out of ground at top of embankment.

Federal Construction Contract Awards Total $4.4 Billion in 1952

The value of contracts awarded for new construction financed wholly or in part with federal funds rose 5 percent in 1952 to $4.4 billion, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. The 1952 total is almost three-fifths as large as the $7.9 billion total for 1942 when federal construction, because of the war effort, was at an all-time high.

The 1951–1952 increase of $219 million reflected, mainly, continued expansion of federal industrial and electric-power facilities, and a sharply accelerated program of federal warehouse building. Because of tapering programs there was a sharp decline in 1952 contract awards for airfields and hospitals. Declines in other types of federal construction, particularly river, harbor, and flood-control work, reflected a reduction in federal funds for projects not directly connected with defense activities.

Industrial construction showed the highest dollar increase from 1951, mainly because of continued expansion by the Atomic Energy Commission. Contract awards for federally owned industrial plant amounted to $1.2 billion in 1952, an increase of 37 percent over 1951. Warehouses (largely for the military) more than tripled in contract value over the year to $261 million, and troop housing increased by 25 percent to $284 million. However, military airfield construction (building and non-building) during the year was reduced by about 50 percent in contract value to $176 million. Contract awards for this work had increased four-fold from 1950 to 1951, as construction was rushed to adapt existing airfields for jet planes.

Electrification contracts awarded in 1952 amounted to more than half a billion dollars, an increase of 84 percent over 1951. The increase for 1952 resulted mostly from contracts let in December at the Tennessee Valley Authority for projects planned to meet increased power requirements for atomic-energy facilities, aluminum plants, and other defense-connected industry in the area.

Contract awards for new federally aided highways advanced 17 percent to a record total of almost $1 billion in 1952, even though some programs were delayed by steel shortages.

Because of the need to supply schools in overburdened defense districts, contract awards for educational building rose 41 percent over the year to a total value of $885 million in 1952—the highest recorded annual total. In contrast, awards for hospital construction dropped by almost 50 percent to a five-year low of $155 million, as current construction programs of the Veterans Administration and the U.S. Public Health Service neared completion.

The federal contract-award totals cover construction on projects in continental United States only, and exclude amounts for classified and secret projects, while including expenditures for atomic-energy and other defense-connected projects.

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Air Force Display Features Military Engineers Meeting

A demonstration of modern Army Air Force planes and equipment was a major feature of the 1953 annual meeting of the Society of American Military Engineers, held at Andrews Air Force Base, Maryland, on May 11. To show the tremendous capacity of modern transport aircraft, a C-124 landed and dramatically unloaded 40,660 lb of aviation engineer equipment in the form of a LeTourneau Tractor with blade and a $^1/_4$-ton jeep. Emerging from a similar unit were a 12-TD Scraper and a 5-TD Dump Truck, with a total weight of 42,180 lb.

Of special interest to the thousand engineers, army officers, and members of congressional military committees present was the breaking of the sonic barrier. Flying a F-86 Sabrejet at a speed of more than 700 mph down from a height of 43,000 ft, a Korean war veteran twice broke the sonic barrier. The resulting dull explosion was heard seconds later.

Other demonstrations included the effect of an F-94B jet engine and afterburner on asphalt pavement put down for the test; a demonstration of fire-fighting equipment; and helicopter delivery of pierced steel runway planking.

Officers of the SAME are Brig. Gen. Dwight F. Johns, M.ASCE, U.S. Army (retired), Piedmont, Calif., president; Maj. Lenox R. Lohr, M. ASCE, president, Chicago Museum of Science and Industry, first vice-president; Burton J. Bell, M. ASCE, Office, Division Engineer, Atlanta, Ga., second vice-president; Col. E. Goring Bliss, assistant vice-president, the Chesapeake and Potomac Telephone Co., Washington, D.C., treasurer; and Col. F. H. Kohloss, U.S. Army (retired), executive secretary.

New Motor Controls Are Ordered for Panama Locks

The first major overhaul of the Panama Canal since it was built forty years ago has begun with a $250,000 order for new motor controls for the locks received by the Federal Electric Products Co., of Newark, N.J. Replacement of the motor controls is part of the first phase of a ten-year plan to overhaul the Canal to enable it to handle more ships. The first phase of the project, to be completed by 1956, will cost an estimated $1,500,000. Prototypes of the eight types of controls have already been built at the company's Newark plant, and delivery of the units for the 398 electric motors (ranging from $7^1/_2$ to 70 hp) will begin soon.

The new motor controls will replace those now in operation without interrupting Canal service, according to officials of the Panama Canal Co. Together with repair of the lock culverts, they will shorten the time required to fill and empty the lock chambers. Traffic through the 50-mile canal, which was first opened on August 15, 1914, has increased steadily, and shutdowns for repairs have been increasingly frequent.

March Sets Record For Aluminum Output

All-time records—daily, monthly, and quarterly—were broken by the United States aluminum industry with the March primary output of 208,919,425 lb, according to Donald M. White, secretary of the Aluminum Association. The quarterly production of 574,007,540 lb is about 3 percent over the previous record of 558,000,000 lb established during the fourth quarter of 1943; the monthly output is 11 per cent above the previous (October 1943) record of 188,100,000 lb; and the daily average high of 6,700,000 lb broke the previous daily average high of 6,600,000 lb set in February. March was also the peak production month of the quarter, exceeding February production by more than 23,000,000 lb.

"The setting of these records means that the capacity of the industry has reached a new level," Mr. White noted, "but since the expansion program is still far from complete, more new records can be expected in the coming months." He said that the amount available for civilian manufacture will depend on the government's stockpiling policy and military demands.

Mrs. Roebling's Contribution to Brooklyn Bridge Marked

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COL. WASHINGTON A. ROEBLING, C.E.
1837 - 1926
COMPLETE THE CONSTRUCTION OF THIS BRIDGE
FROM THE PLANS OF HIS FATHER
JOHN A. ROEBLING, C.E.
1806 - 1869
WHO GAVE HIS LIFE TO THE BRIDGE
BACK OF EVERY GREAT WORK WE CAN FIND
THE SELF-SACRIFICING DEVOTION OF A WOMAN
THIS TABLET ERECTED 1951 BY
THE BROOKLYN ENGINEERS CLUB
WITH FUNDS RAISED BY POPULAR SUBSCRIPTION

On May 24, seventieth anniversary of the opening of Brooklyn Bridge, the Engineers' Club of Brooklyn unveiled this memorial tablet, commemorating the contribution of Emily Warren Roebling to the building of the bridge. The wife of Col. Washington A. Roebling, M. ASCE, who completed construction of the bridge from his father's plans, Mrs. Roebling acted as spokesman for her husband on construction of the project after he was stricken with caisson disease. At the bridge-opening ceremonies on May 24, 1883, she was cited by the mayor as among those "who have made humanity itself their debtor for a successful achievement . . . . and for consecration of all personal interest to the public weal . . . ." Participants in the May 24, 1953, ceremony included D. B. Steinman, M. ASCE, who was retained by the City of New York for planning the recent modernization of the bridge, and Frederick H. Zurmuhlen, M. ASCE, Commissioner of the New York City Department of Public Works, who accepted the tablet on behalf of the city. Theodore Belzner, Affiliate ASCE, served as chairman of the Club's Memorial Committee.

Westinghouse Air Brake Co. Buys Earthmoving Business

A general agreement covering purchase by the Westinghouse Air Brake Co. of the earthmoving, tractor, and related business of R. G. Le Tourneau, Inc., its international sales and distribution organization and its Peoria, Ill., and Toccoa, Ga., plants, is reported by the presidents of the two companies. The Le Tourneau organization will retain and continue to operate its Vicksburg, Miss., and Longview, Tex., plants, and manufacture special products for the U. S. Government—land-clearing equipment, cranes, and other products not related to earthmoving. Mr. Le Tourneau, who is a pioneer in the earthmoving equipment industry, will continue his research and development work in the field for the new owners.

Westinghouse Air Brake will probably organize a new subsidiary, called Le Tourneau-Westinghouse Company, to take over the earthmoving operations.

Freeman Fund Scholarship Made Available by B.S.C.E.

Applications for a Boston Society of Civil Engineers Scholarship under the John R. Freeman Fund, covering a year's study of research work in connection with hydraulics or an allied science, will be received through July 15. The scholarship, carrying a stipend of $3,000 for single and $3,600 for married men, provides for tuition, traveling and living expenses. Candidates must give their age, qualifications, birthplace, education, experience, and proposed plan of study. A photograph and not less than five letters of reference are also required. Preference will be given to residents of New England and eastern New York, north of New York City.

Applications should be addressed to the Freeman Fund Committee, c/o the Secretary of the Boston Society of Civil Engineers, 715 Tremont Temple, Boston 8, Mass.

Jordan to Have Power And Irrigation Project

Earmarking of $40,000,000 for a power and irrigation project in the Jordan Valley is announced by the United Nations, following signing of a major agreement in Amman, capital of Jordan, on March 31, by Anwar Nusseiby, Jordan's Minister of Reconstruction and Development, and Leslie J. Carter, acting director of the United Nations Relief and Works Agency. Part of a $200,000,000 UNRWA self-support fund for Arab refugees from Palestine, the present project provides for construction of a 400-ft-high dam, across the Yarmuk River, which will feed two power stations, with a total output of 10,000 kw, and irrigate 95,000 acres in the Jordan Valley below the confluence of the Yarmuk and Jordan rivers and the Dead Sea. It is expected that 20,000 refugee families can be rehabilitated by the project.

By the terms of the agreement, the Jordan government will speed the completion of economic and engineering surveys and provide all information required. Aerial surveys have already been completed under a British loan and Point IV funds, and an access road is being built to permit transporting heavy machinery to the construction site.

Authority Formed to Study New York Transit Financing

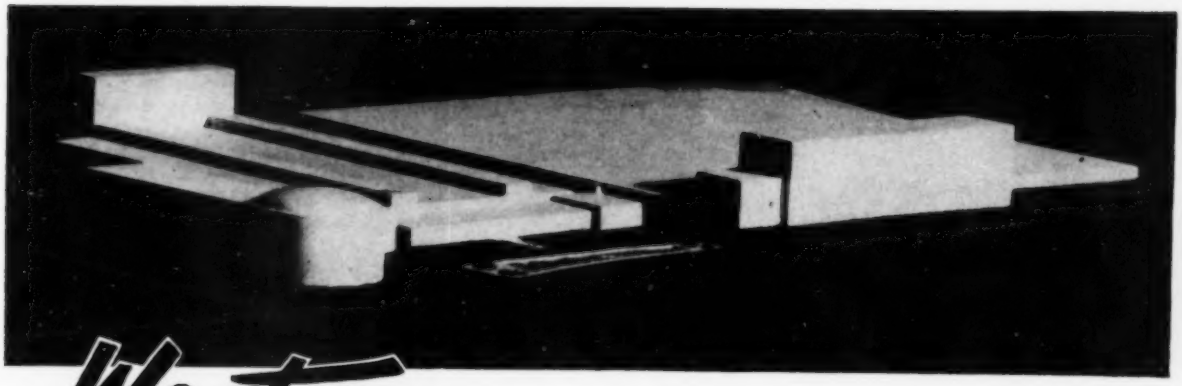
A five-man transit authority has been formed in New York City to take over the municipal transit lines and run them at a fare that will cover all operating expenses. Authorized by the 1953 state legislature and sponsored by Gov. Thomas E. Dewey, the five-man board has already begun a study of the operation and financing of the transit system, with the aim of determining the feasibility of service cuts and economies suggested by Sidney H. Bingham, chairman of the Board of Transportation, in a recent report to the Board of Estimate.

Mr. Bingham's report estimated an annual saving of $24,800,000 by eliminating some of the city bus lines where they are in competition with the subways and abandonment of the Myrtle Avenue elevated line in Brooklyn and of the Third Avenue elevated line south of 149th Street in Manhattan. The authority is also studying transit surveys made in 1951 by Day & Zimmermann, of Philadelphia, and Coverdale & Colpitts, of New York, and a power supply study prepared by the J. G. White Engineering Corp.

The members of the New York City Transit Authority are Maj. Gen. Hugh J. Casey, M. ASCE, chairman, who has been associated with Schenley Industries, Inc., since his retirement from the Army; Eugene F. Moran, chairman of the board of the Moran Towing and Transportation Company, Inc.; Henry K. Norton, director and vice-president, Walter Kidde & Co.; and William G. Fullen and Brig. Gen. Ephraim F. Jeffe, retired. With the exception of Mr. Moran, the members of the Board were appointed by Governor Dewey and Mayor Impellitteri. Mr. Moran was named by the other four, and the group chose General Casey as chairman.

Aftermath of the War in Korea

Damage to Korean railroad structures inflicted by retreating North Koreans is shown in these examples from an album of photos of typical war demolition presented to ASCE by Kyung Mo Ahn, member of the Korean Society of Civil Engineers and Chief of Construction, Ministry of Transportation, Republic of Korea. The album may be seen in the Reading Room at ASCE headquarters.



Western OVERCOMES BAFFLING FOUNDATION CONDITIONS FOR DETROIT'S NEW WATER SUPPLY STRUCTURES

PROJECT: Foundations for the high lift plant, switch house, weir chamber, filter building, and wash water building for the Department of Water Supply of the City of Detroit.

SPECIFICATIONS: Specifications required the pile to take 200% of working load with maximum GROSS settlement of ¾ in. Sweep specifications required that a part of the bottom of the pile be seen from the top when a light was lowered into the pile. No concrete could be poured in any pile until it was established that pile was outside the "radius of heave." As many as 2000 pile casings were unfilled at one time. It was further required that the pile be end-bearing.

All piles had to be driven 90 to 120 ft. to hardpan through a heaving, shifting, hard clay upper crust overlying a restless stratum of soft clay mixed with gravel and boulders.

DIFFICULTIES: 1. Piles installed in the experimental stage moved laterally in various directions for distances measured in inches during a three week period when no work was being done. 2. Many of the test piles subsided after a long upward movement. 3. Entire volume of soil displaced by piles should have caused a maximum ground heave of 2.7 ft. Yet the maximum ground heave actually exceeded 4 ft.! 4. When bored 20 ft. or more through the hard upper stratum ahead of driving operations, core holes moved as much as thirteen inches without any distortion of the holes themselves. 5. The projectile pipe section developed fairly sharp bends when obstacles were encountered so that the pile could not meet the plumb and sweep specifications.

RESULTS: WESTERN installed 4,824 composite projectile piles with a total length of over half-million feet. Pile load capacity was checked by seven 100-ton load tests. Maximum GROSS settlement in any pile was ½ in. By lowering a metal cone gage of ½ in. less diameter than inside diameter of shell, it was found that there was no distortion in any of the piles. Job was completed within specified 24 week period.

Write for literature entitled, "The Mystery of the Restless Substratum," giving full details of the project.

COMPLETE FOUNDATIONS FOR

INDUSTRIAL PLANTS, POWER PLANTS, PIERS AND DOCKS, BRIDGES, AIRPORTS, STEEL PLANTS, HOUSING PROJECTS, COMMERCIAL BUILDINGS, SCHOOLS, ETC.

WESTERN FOUNDATION CORPORATION

308 W. Washington St., Chicago 6, Ill. • 2 Park Avenue, New York 16, N. Y.

Cellular construction of cofferdams provides dry working area some 31 to 36 ft below river pool with additional 10 to 14-ft protection against possible rise in river elevation (see below). Multi-stage access stairway at left was one of many safety measures used on the job. Left-hand views shows one of the cofferdams between completed bridge piers.

West Virginia Highway Bridge Piers Built Inside Cellular Cofferdams

R. C. JENNINGS

Engineer, The Contracting Division, Dravo Corp., Pittsburgh, Pa.

Effective use of cellular cofferdams was one of the highlights in the construction of four main piers recently completed for a new highway bridge over the Ohio River at Wheeling, W.Va., for the West Virginia State Road Commission by the Contracting Division of the Dravo Corporation, Pittsburgh. The four-lane bridge will relieve the strain of heavy traffic (on U.S. Route 40) over the historic Wheeling suspension bridge some 600 ft downstream from the new structure.

The specifications for constructing the main piers required the use of a double-skin cofferdam, visual examination of the exposed rock after foundation preparation, and exploratory drilling to determine the condition of rock underlying the finished excavation. Previous examination had shown that rock would be encountered 18 to 36 ft below the normal river level and that excavation would be made into the rock for an additional 4 to 12 ft.

Use of cellular cofferdams made it possible to establish a safe and economical working plan for the construction of the piers. Three of the cofferdams fell into the 31-to-36-ft below-pool range and were of cellular construction. The fourth, only 18 ft below normal river elevation, was constructed as a single-skin, steel sheetpile, internally braced structure. Absence of internal bracing increased working area inside the cofferdam for shooting, mucking, form building and concreting operations, and provided space on top of the cells for storage and handling materials.

Each of the three cellular cofferdams was composed of ten steel sheetpile cells, spaced in an oval pattern around the pier footing and tied together with intermediate arcs and filled with sand and gravel dredged from the river bottom during site excavation and access dredging.

The Ohio River bed, which is rich in deposits of sand and gravel, also contains many boulders of the same glacial origin. To preclude the possibility of hitting any of these boulders while driving the sheetpile, the site was excavated quite deep and only a minimum amount of driving was required.

After excavating the site of the first two cells to be placed, a wood framework template, 16 ft in depth, was floated into position and held until its correct location had been determined by triangulation from the bank. Two 14-in. H-beams were dropped through the template and driven with a pile hammer to secure the template in place. Steel sheetpiling was then set around the circular template, making the cylindrical cell, and penetration into the soft rock was secured to prevent sliding after unwatering. After this the template was removed and placed for the second cell. By working in two directions from the first setting of two cells and the intermediate arcs, it was possible to fill cells at one end of the string while piling was set and driven for a new cell on the other end.

Water was pumped from the cofferdam steadily, but slowly. As the water level dropped, weep holes were burned in the sheetpile in the inside wall of the cofferdam to allow water in cells and intermediate arcs to drain out of the sand and gravel fill material. Draining reduced the hydrostatic head against the inside row of sheetpiles of the coffer and left a relatively dry wall to hold back the water.

After the cells were capped with concrete, a whirler crane that could reach all points within the work area was set up on the cofferdam. Site excavation and predredging had cleaned off most of the overburden from the rock, and the whirler crane removed the remainder of the sand and gravel to rock. By using busters and cutting a channel around the perimeter of the footer it was possible to shoot the soft shale rock to the finished face without line drilling. Only a small amount of trimming was necessary to bring the vertical walls to the neat line which was required for the concrete footing.

Pumping from the cofferdams was continued until the piers were poured up to a point above normal water elevation. Because of the double-wall construction of the cofferdam, pumping never became a serious problem and the cofferdam was exceptionally dry. The bottom of the footer of the deepest of the piers, No. 8, was 45 ft below the normal water elevation, and the footers for piers 6 and 7 were 39 ft below the pool.

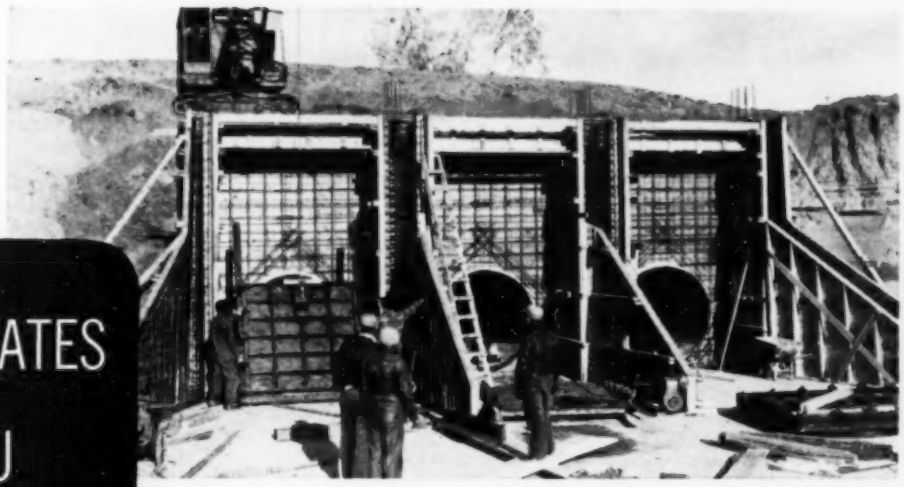
After each of the piers had been poured to a point above water the coffers were allowed to fill. The concrete cell caps were then broken out; the cell fill of sand and gravel was excavated to grade, and the steel sheetpiling was pulled with derrick boats. About a month was required to place each of the cofferdams, and about the same amount of time was required to remove them.

Throughout the construction of the cofferdams and piers the versatility and flexibility of the fleet of derrick boats, mixer boats and barges was amply demonstrated.

Three of the piers were located on the shallow side of the Ohio River in a channel where depths averaged about 4 ft. The fourth pier was located at the river's edge on the opposite side. Thus dredging was necessary to bring floating equipment, with drafts up to 7 ft, into the shallow water. The dredged material was used to fill the cofferdam cells.

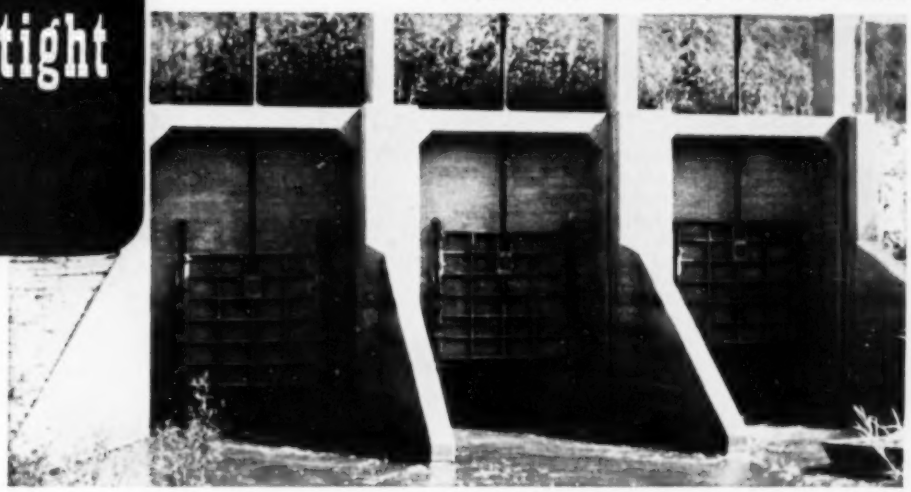
In the site excavation for the piers and cofferdams, derrick boats were constantly at work handling the wet excavation, placing and removing the fill from the cells of the cofferdams, and backfilling the sites after removal of the cofferdams. These derrick boats could also move about quickly to assist the stationary rigs on the cofferdams in the many lifting, form placing, and concreting operations.

THESE GATES GIVE YOU a watertight case



Three Armco Slide Gates being installed in 1944.

Same gates today. Naturally, they are in perfect condition.



For more than 40 years Armco Water Control Gates have been making water "toe the mark" in irrigation, drainage, flood control and sewage systems. Because of this experience, you can depend on Armco to supply a gate that meets your needs *exactly* — without over-design or other costly extras not warranted in your application.

Armco Gates are based on simple, proved designs that make them easy to specify, install and operate. Practical watertightness is assured. They rate high in economy because of low cost and long life with little maintenance.

These gates are available in a wide variety of types, models, sizes and materials for practically every water control purpose. Types include: simple flap gates, small hand-operated slide gates, lift-operated slide headgates, metergates, radial gates and roller bearing gates — supplied in 27 models.

Ask us for more information on the Armco Gate that interests you. But if in doubt about the best solution to your water control problem, ask us for engineering assistance and recommendations. We will be glad to help you. Armco Drainage & Metal Products, Inc., 3553 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO WATER CONTROL GATES

ARMCO

Chamber of Commerce Issues Booklet on Water Resources

A plan for the utilization of the water resources of the country, prepared by the Natural Resources Department of the Chamber of Commerce of the United States, has been outlined in a special publication of the Chamber entitled *Our Water Resources*. The plan emphasizes "local initiative supported by enlightened public interest and coordinated through all levels of government." Copies may be obtained from the Chamber of Commerce, Washington 6, D.C.

Also available from the Chamber is a booklet, entitled *Policy Declarations on Natural Resources*, which gives a complete statement of the National Chamber stand on water and other natural resources.

Film on Earthquakes Is Made Available

A new 16-mm color film with sound, entitled "Earthquakes and Construction," has been prepared by the West Coast Lumbermen's Association. The film is a pictorial study of the effects of numerous earthquake shocks on buildings in Kern County, California, during July and August 1952. With a running time of about ten minutes, the film stresses the value of sound design and construction in regions where earthquakes are a probability. School construction is especially featured.

Bookings can be arranged through the West Coast Lumbermen's Association, 1410 S. W. Morrison Street, Portland 5, Oreg. There is no charge.

Electric Power Produced by Experimental Reactor

Production of useful amounts of electric power by nuclear energy has been achieved from successful operation of a new type of reactor—an experimental homogeneous reactor—at Oak Ridge National Laboratory, according to an announcement from the Atomic Energy Commission. Scientists there brought a pilot-model of the reactor system up to its full design power of 1,000 kw of heat output, and then switched the reactor system to a turbine-generator, permitting production of about 150 kw of electricity—about enough to meet the estimated needs of 50 average five-room dwellings.

Capable of producing both fissionable material and electric power, the small homogeneous reactor was developed at Oak Ridge National Laboratory, which the Union Carbide and Carbon Corp, is operating for the AEC. Though many problems remain to be solved, project scientists say that the demonstration of the utility of homogeneous liquid-fuel, reactor systems is an important step toward economical production of electricity by means of nuclear reactors.

In the homogeneous reactor, a single homogeneous solution serves as fuel, moderator, and coolant. The heat generated by the nuclear reaction of the uranium fuel in the solution is removed by pumping the hot radioactive liquid through a heat exchanger or boiler, which produces steam to drive a turbine-generator. Though a homogeneous-type reactor was built at the Los Alamos Scientific Laboratory in New Mexico in 1944 and another is nearing completion at North Carolina State College, they are low-power research reactors. The Oak Ridge unit is the first to operate at a temperature and power high enough for production of steam to run a standard industrial turbine-generator.

Construction of the Oak Ridge reactor was started in March 1951, following two years of development and design by Oak Ridge National Laboratory scientists. Construction and fabrication of the reactor and its auxiliaries, including building and site facilities, cost about $1,100,000, and the cost of research and development was approximately $3,000,000. The engineering design and construction were performed under the supervision of C. E. Winters, with S. E. Beall supervising actual construction and experimental testing.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"I have heard some complaints," said Professor Neare, "that our discussion of cubes is wasting the time of this Engineers Club. The shape, they claim, is not suitable for building blocks, but only for iniquitous dice, highball ice and cocktail sugar. Maybe engineers know too little about cubes to utilize their perfection and symmetry. Guest Professor Fortescue Bletz, the cubelets expert, will teach us a little more."

"It's a simple problem," began Professor Bletz. "I expect even Joe Kerr can tell us the answer, leaving the theory to Cal Klater."

"Simple!" protested Joe. "Here's what you asked, in letters of one syllable: Find positive integers a, b, c, d and e (which were edges of cubelet bird cages) to fit

$$a^3 + b^3 + c^3 = d^3 \text{ and } \ldots \quad (1)$$

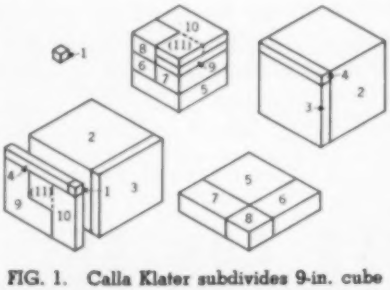


FIG. 1. Calla Klater subdivides 9-in. cube into eleven blocks for reassembly in 1-, 6-, and 8-in. cubes; ten blocks for re-entrant dissection.

$$(a + b)^3 + (b + c)^3 + (c + d)^3 = e^3 \quad (2)$$

and then answer 'How small is the smallest?' Well, with five unknowns we need three more equations, one of which is implied in *integers*. Maybe Cal found the other two implied in the wingspread of wrens and hawks; I didn't."

"I'm surprised," exclaimed Cal. "After reams of analysis I resorted to the typical Kerrvian synthesis known vulgarly as cut-and-try and found the answer. Starting with the guess $a = 3$, $b = 4$, $c = 5$, $d = 6$ fitting Eq. (1), I found it failed to fit (2). Permuting a, b and c gave me 5 more trials, all failing. But when I started on $a = 1$, $b = 6$, $c = 8$, $d = 9$, I was thrilled to find (2) become $7^3 + 14^3 + 17^3 = 20^3$. There may be other similar sets, but none with a smaller cage than $a = 1$."

"Right you are'" conceded Professor Bletz, "and since you didn't mention the unit, I'll add that the tiny wrens do nicely in their space of a cubic cubit. Incidentally, it is easy to find lots of quadruplet sets like these. Using small integers, start with p and t and make $q = 3t - p$; then from $p^3 + q^3 = 9rst$, find rs and factor so that $r > s$. From these generators,

$$a = pr - s^2 \qquad c = r^2 - ps$$
$$b = qr + s^2 \qquad d = r^2 + qs$$

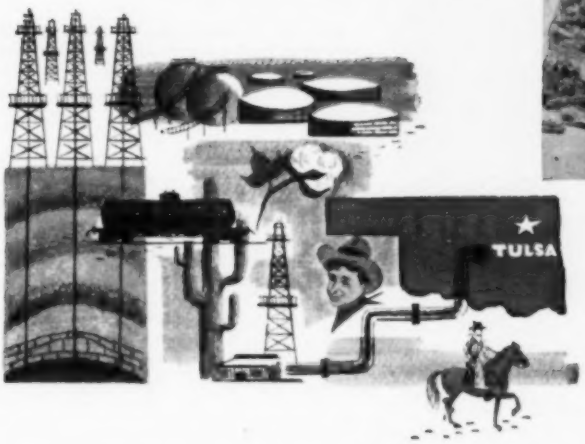
will satisfy Eq. (1)."

"Thanks, Forty," said Professor Neare, "and I'll add that there are at least 27 prime sets with $d < 100$, compared to only 16 for the pythagorean $a^2 + b^2 = c^2$.

"Now for another episode in the transitory life of Al E. Dayde. Realtors Bell and Lee had engaged Al to subdivide Bell-Lee Acres, but with down payments for lots barely covering expenses, they were embarassed for cash and proposed that Al take a third of the 360 lots remaining for his fee. Having observed that a third of the remaining lot numbers were divisible by 5, a fourth by 6, and a fifth by 9, canny Al countered with an offer to take every lot number divisible by 3, which was accepted. How did Al probably do?"

[*Cal and Calla Klaters were: Richard Jenney, S. K. Rueball (Keith Jones), James R. Bole, Elisabeth Gittings, Flo Ridan (Charles G. Edson), Sauer Doe (Marvin Larson), and O'Kay (Otto H. S. Koch). Mrs. Gittings also showed (Fig. 1) how the 9-in. block can be cut into cubelets with less than the 12 pieces given as the answer in April.*]

Tulsa Prefers Concrete Pressure Pipe



In 1923 when Tulsa reached out to Spavinaw Creek for pure, spring-fed water it selected concrete pressure pipe for the flow line. Fifty-two miles of 54- and 60-inch concrete pressure pipe were installed to carry a maximum of 25 mgd.

Twenty-eight years later Tulsa again chose concrete pressure pipe to help increase its water supply. The new line, completed last year, parallels the original installation and boosts Tulsa's capacity to 63 mgd. 66- and 72-inch pipe were used.

The confidence Tulsa engineers have in concrete pressure pipe is evidenced by the fact that it was selected a second time for the city's water supply system. The original installation had proven that concrete pressure pipe is efficient, economical, and lasting.

If your city is planning additional water lines, or replacements for old lines, be sure to investigate the distinct advantages of concrete pressure pipe.

Water for Generations to come

Concrete PRESSURE Pipe

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

DECEASED

David Anderson (M. '27), age 71, past-president of the Institution of Civil Engineers and senior partner in the London civil engineering firm of Mott, Hay & Anderson, died on March 27. He had been knighted by King George VI in 1951. In 1913, Sir David became associated with Mott & Hay, as assistant chief engineer and in 1922 was made a partner in the firm. He was a graduate of St. Andrew's University.

Edward Stewart Anderson (M. '19), age 78, retired engineer of Laguna Beach, Calif., died on March 17. For almost 15 years (1931–1946) Mr. Anderson was engaged as a civil engineer at the Hakalau Plantation Co., Hakalau, Hawaii. Prior to that he was president and chief engineer of the Bannock Engineering Co., Ltd., Pocatello, Idaho.

Theodore Barbato (M. '27), age 64, since 1945, a consulting structural engineer with offices in New York, N.Y., died in that city on April 6. In recent years, Mr. Barbato had specialized in the design of church and school buildings. Earlier he was employed as a structural engineer by several New York firms, and for 18 years (1924–1942) was consulting and chief engineer for J. T. McCoy, Inc. He was a graduate of Cooper Union.

Raymond John Barrows (A.M.'44), age 56, died on April 1, at Guantanamo Bay, Cuba, where he had been with the U.S. Naval Operating Base as a consulting engineer for several years. Living in Cuba since 1926, Mr. Barrows was previously employed by the Fidelity Sugar Co., the Frederick Snare Corp., and the Antilla Sugar Estates.

Rollo Kimball Blanchard (M. '25), age 68, former vice-president of the Neptune Meter Co., New York, N.Y., died on April 25, while vacationing at Clearwater, Fla. Connected with the Neptune company since 1913, Mr. Blanchard became vice-president in 1929, and served in that capacity until his retirement in 1952. He was an alumnus of Cornell University, and had been active in the New York section of the American Water Works Association.

Alexander Bonnyman (M. '08), age 84, since 1937 president of the Blue Diamond Coal Co., Knoxville, Tenn., died at his home in that city on April 15. After graduating from the University of Kentucky in 1888, Mr. Bonnyman worked for several Southeastern railroad lines for 20 years before entering the mining field. He served as ranking officer of a group of coal mining companies operating in Alabama, Kentucky, Tennessee, and Virginia, which were consolidated in 1927 under the name of the Blue Diamond Coal Co.

Joseph L. Burkholder (M. '22), age 68, general manager and chief engineer of the San Diego County Water Authority since 1944, died in San Diego, Calif., on April 6. A specialist in water development, Mr. Burkholder was with the Bureau of Reclamation from 1910 to 1922, and was chief engineer for the Middle Rio Grande Conservancy District in New Mexico from 1926 to 1932. He joined the Los Angeles Metropolitan Water District in 1932 as superintendent of construction and advanced to assistant general manager. A director of the Los Angeles Metropolitan Water District, he supervised construction of the Colorado River and San Diego aqueducts. He had studied at the University of Kansas.

Daniel Charles Newman Collins (M. '01), age 87, retired engineer and architect of Cranford, N.J., died at Dallas, Pa., where he had recently made his home. Mr. Collins served as the Cranford township engineer from 1901 to 1933. During this period he was also consulting engineer for the Lidgerwood Manufacturing Co., and was connected with the design of many industrial and school buildings in the New York area.

Clyde Warren Wood (A.M. '19), age 62, founder and president of Clyde W. Wood & Sons, Inc., of North Hollywood, Calif., died on March 31. In the general contracting business for more than 30 years, he had participated in construction work throughout California, was one of the joint venture builders on Shasta Dam, and worked for such groups as the Los Angeles Metropolitan Water District, Bureau of Reclamation and the Corps of Engineers. Mr. Wood was a past-president of both the Southern California and San Francisco chapters of the Associated General Contractors.

Clyde W. Wood

Douglas Cornell (A.M. '99), age 84, who retired in 1939 after 40 years as structural engineer in the Buffalo, N.Y., Division of Buildings, died on March 12. For part of this period Mr. Cornell had also been Acting Commissioner of Public Buildings. Before entering the Buffalo Division of Buildings in 1899, he was in the New York Engineer Department for six years engaged on canal and highway surveys. He was educated at Rensselaer Polytechnic Institute.

Robert Curtis Cutting (A.M. '13), age 71, who retired in 1950 after 20 years as civil engineer in the New Orleans District of the Corps of Engineers and had been living there since his retirement, died on April 14. Following his graduation from Massachusetts Institute of Technology in 1905, Mr. Cutting joined the Corps as a junior engineer in the Pittsburgh District. For eight years (1914–1922) he was an engineer for the government of Australia on the Murray River development. Upon his return to the United States, he resumed his duties with the Corps.

William Tully Dorrance (A.M. '10), age 79, retired consulting engineer for the New Haven Railroad, died in New Haven, Conn., on April 7. Mr. Dorrance started with the railroad as chief draftsman at the Boston office in 1915, was transferred to the New Haven office in 1931 as assistant to the chief engineer, and in 1946 was made consulting engineer. Active in Society affairs, he was president of the Connecticut Section in 1924. Mr. Dorrance was an alumnus of Brown University and the Massachusetts Institute of Technology.

James C. Hain (A.M. '01), age 82, retired engineer of Pasadena, Calif., died on December 4. Continuously connected with the Los Angeles Cement Gun Co., for more than 35 years, Mr. Hain had been manager and president. He was an alumnus of the University of Wisconsin, class of 1893.

John Sherman Heilmann (A.M. '42), age 53, since 1947 Los Angeles district engineer for Morrison-Knudsen Company, Inc., died at his home in that city on March 28. Before joining Morrison-Knudsen, Mr. Heilmann had been general superintendent of construction for MacDonald & Kahn, Inc., San Francisco; engineer for the Western Pacific and Union Pacific railroads; assistant to the city engineer of San Francisco; and supervising engineer for Peter J. McHugh of San Francisco.

John Robert Hicks (M. '19), age 82, engineer with Corbet & Tinghir & Co., of New York, N.Y., died in February. An alumnus of Virginia Military Institute, Mr. Hicks was employed as a structural engineer by Lichter & Jens, St. Louis, Mo., for 16 years—1902–1918. He was a member of the Pittsburgh firm of Eavenson, Alford & Hicks, from 1920 to 1935, and later was in private consulting for several years.

Nathan Howe Jones (M. '26), age 67, project manager for the Fluor Corp., Ltd., New York, N.Y., died at his home in that city in April. Mr. Jones attended the University of California and served as a lieutenant colonel during World War I. At various times he had been connected with the J. G. White Engineering Corp., on construction in Persia, Panama, Venezuela and New York; the M. W. Kellogg Co., New York, N.Y.; E. B. Badger & Sons, Co., Boston, Mass.; and the Kellex Corp., at Oak Ridge, Tenn.

Cyrus Alan Melick (M.'25), age 70, until recently district bridge engineer for the Iowa District Office of the Bureau of Public Roads, at Ames, died in Clarinda, Iowa, on April 24. A graduate of Ohio State University, Mr. Melick taught civil engineering at Michigan State and Union colleges. He was bridge engineer for the Michigan State Highway Department from 1920 to 1933, and joined the Bureau of Public Roads in 1934.

John William Miller (A.M. '13), age 73, service engineer with the Vega Aircraft Corp., Bothell, Wash., died in Seattle, on February 26. A graduate of the University of Nebraska, Mr. Miller was professor of civil engineering at the University of Washington from 1909 to 1919 and 1927 to 1937. In the intervening years he was president of the J. W. Miller Aircraft Corp. He was the first chief engineer of the Boeing Aircraft Co.

Sterling Ross Mitchell (M. '45), age 53, engineer with Howard, Needles, Tammen & Bergendoff at their Princeton, N.J., field office, died on December 29. An alumnus of the University of Texas, Mr. Mitchell was connected with the Texas Highway Depart-

ment at Austin from 1921 to 1925, and from 1931 to 1942. In the interim he worked for two consulting engineering firms—Montgomery and Ward, and C. L. Hasie; and the Hudspeth County (Texas) Road District. During World War II, Mr. Mitchell served as a major in the Corps of Engineers.

John Joseph Monahan (Aff. '04), age 84, former president and treasurer of the Lowell (Mass.) building firm of Edwards & Monahan, died in Lowell on April 10. His home was in West Chelmsford. Prior to the formation of his partnership in 1904, Mr. Monahan had been employed by Mr. Edwards for 18 years.

Frederick Henry Pond (A.M. '14), age 70, chief engineer of the New York City Bureau of the Budget, died at his home in Hollis, Queens, N.Y., on April 20. Engaged in municipal service continuously since 1909, Mr. Pond was assistant engineer and supervisor of the City Board of Water Supply; assistant engineer of the Department of Parks; and since 1929, a member of the Bureau of the Budget. Mr. Pond received a degree in civil engineering from New York University.

Herbert Oswald Sauer (M. '43), age 64, associated with Consolidated Gas, Electric Light and Power Co., Baltimore, Md., for over 38 years, died on April 27. He retired as chief draftsman of the electric division in December 1952, and since that time was with the Delta-Star Electric Division, H. K. Porter Company, Inc., in its Chicago office. Born in Germany, Mr. Sauer graduated from the Chemnitz and Dresden Schools of Technology.

Hugh Allen Shrader (J.M. '51), age 25, lieutenant, U.S. Air Force, was killed in an accident on February 21. Soon after his graduation from Virginia Polytechnic Institute in 1951, Mr. Shrader entered military service and was stationed at the Air Installations Office, Washington National Airport in Washington, D.C.

Wesley Burnham Walraven (M. '46), age 58, engineer of the Springfield (Ill.) Sanitary District since 1924, died in New Orleans, La., on March 16. In the Illinois state service during his entire career, Mr. Walraven had served as office engineer for the East St. Louis District of the Illinois Division of Highways and an assistant highway engineer with the Bureau of Bridges at Springfield. A veteran of both World Wars, he held the rank of colonel in the Corps of Engineers from 1942 to 1946. Mr. Walraven was an alumnus of the University of Illinois.

Guthlac Wilson (M. '42), age 50, a member of the London firm, Scott and Wilson, was killed in an airplane accident near Dares-Salaam on March 29. Dr. Wilson graduated from London University in 1921 and received a graduate degree from Harvard University in 1939. For more than 15 years he was connected with Braithwaite & Co., Engrs., Ltd., on construction work throughout India. During the war Mr. Wilson served as Director of Constructional Design, Ministry of Works and Buildings, at London.

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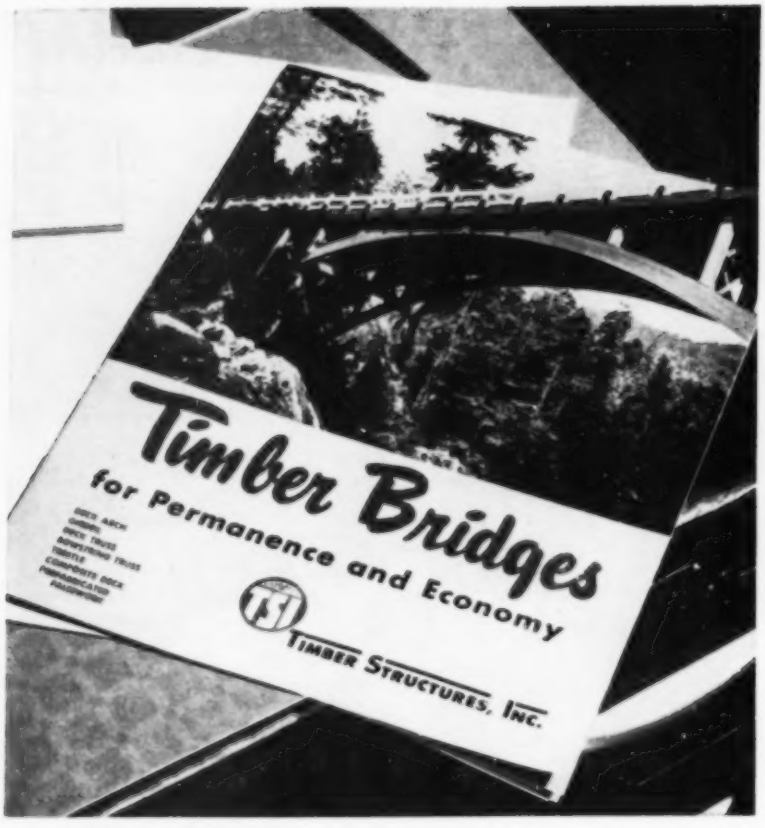

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NEWS OF ENGINEERS

Mitchel Goldenthal (left), commanding officer of the 1903d Engineer Aviation Battalion, receives the Legion of Merit "for exceptionally meritorious conduct in the performance of outstanding service," from Gen. S. P. Wright, deputy commanding general of the Fifth Air Force. Under Major Goldenthal's supervision, the 1903d recently completed a large forward base for the Fifth Air Force in Korea, said to be the largest cold weather earthmoving and concrete placing job in the history of military construction.

Henry A. Alderton, supervising engineer for the U.S. Bureau of Public Roads at San Francisco, Calif., is on a temporary assignment as engineer in charge of public roads for the Seward (Alaska) District.

David V. Auld, formerly superintendent and chief engineer of the Water Division, District of Columbia Government, is now head of the Department of Sanitary Engineering there. **Ralph E. Fuhrman,** superintendent of the District's sewage treatment plant, has been assigned as his assistant.

Clarence H. Ax, until recently engineer and estimator for the Jones-Kissner Construction Co., St. Louis, Mo., has joined the staff of the Vollmar Bros. Construction Co., at St. Louis. He is currently serving as a vice-president of the St. Louis Section.

Robert B. Brooks, consulting engineer of St. Louis, Mo., was unanimously elected to membership on the St. Louis Board of Freeholders for a Metropolitan Transit Authority, at a meeting on April 10 of the circuit judges and acting mayor of St. Louis.

Kenneth Brunner has resigned as associate highway engineer with the California State Division of Highways, to accept the position of chief design engineer with the firm of Francis H. Bulot, Consulting Engineers, of Los Angeles.

James E. Cahill, since 1934 vice-president of the Great Lakes Dredge and Dock Co., Chicago, Ill., was honored by company officers and employees at a luncheon, held on May 1, to mark the fiftieth anniversary of his association with the firm.

Eldon V. Hunt has resigned as district superintendent for the Transcontinental Gas Pipeline Corp., at Alexander City, Va., to join Ebasco Services, Inc., of New York as an engineer. Employed in the natural gas industry since 1928, Mr. Hunt had been with Transcontinental since 1949.

Thomas S. Clark of Bayside, N.Y., has retired after 16 years in government work and 30 years as chief engineer with the Alphons Custodis Chimney Construction Co., New York, N.Y. Since 1947 he has been serving as chief building inspector of the Federal Public Housing at New York.

George F. Dixon, Jr., district engineer for the Corps of Engineers at Vicksburg, Miss., has been reassigned to the Office of the Chief of Engineers, Washington, D.C.

C. George Dandrow, vice-president of the Johns-Manville Sales Corp., New York, N.Y., was reelected president of the New York Building Congress at its recent 32nd annual meeting at the Hotel Astor.

John E. Davidson has received a promotion from vice-president to executive vice-president of the Massman Construction Co., Kansas City, Mo. Mr. Davidson served as assistant and general manager of the atomic energy diffusion plant at Oak Ridge, Tenn., from 1943 to 1947, and was connected briefly with the Guy F. Atkinson Co., and J. A. Jones Construction Co., on the AEC construction program at Hanford, Wash.

John A. Focht, Jr., formerly with the Soils Division of the U.S. Waterways Experiment Station, Vicksburg, Miss., is now an associate engineer with Greer & McClelland, consulting foundation engineers of Houston.

George F. Ferris, since 1946 director, vice-president and general manager of Raymond Concrete Pile Co., of New York City, has been elected president of the firm, succeeding **William V. McMenimen,** who has retired (May 15th, page 88). He was previously associated with the Turner Construction Co., New York, N.Y., as a director and vice-president.

Carl A. Bock, for ten years chief engineer of the Puerto Rico Water Resources Authority, was appointed executive director on April 15 to succeed the late **Antonio Lucchetti.** Identified with the development of Puerto Rico water resources since 1935, Mr. Bock directed the planning and construction of the Caonillas Hydroelectric Project and Extension, the 80,000-kw steam-electric generating station at San Juan, the Southwestern Puerto Rico power and irrigation

Carl A. Bock

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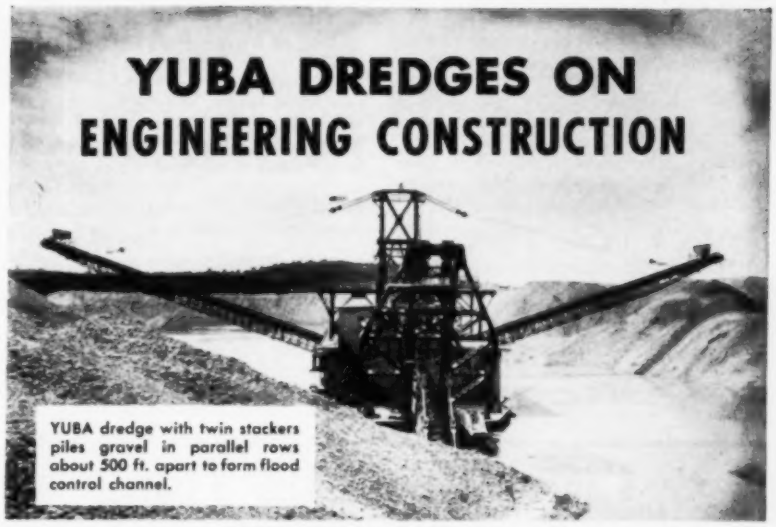

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project, and other development projects. He is a former director of engineering for the Tennessee Valley Authority.

Walter L. Huber, ASCE President, represented the Society at the inauguration of fellow officer, **G. Brooks Earnest,** as third president of Fenn College, Cleveland, Ohio, on May 9. Professor Earnest is Vice-President of the Society from Zone III.

William H. Hall, dean of the Duke University College of Engineering since its establishment in 1939 and member of the faculty for 38 years, has resigned as head of the College of Engineering, but will continue to serve on the Duke staff as the first J. A. Jones Professor of Engineering. He plans to retire from teaching some time next year.

Benjamin F. Fairless, chairman of the board of directors and chief executive officer of the U.S. Steel Corporation, is the recipient of the Vermilye Medal of the Franklin Institute for 1953, for "his outstanding contributions to the field of industrial management . . . ." Formal presentation of the award was made on May 20, with Mr. Fairless delivering the Edward G. Budd Lecture. Mr. Fairless was the winner of the John Fritz Medal for 1952.

C. M. Howard retired on May 31 after completing 24 years as engineer-manager with the Concrete Products Association of Washington. He will continue to serve the association as a consultant and will be available to other clients in a similar capacity. Mr. Howard is past-president of the Seattle Section and numerous other local chapters of professional societies. He will be succeeded by **W. Stephen Callender,** who comes to the Concrete Products Association from the W. H. Witt Company, of Seattle.

I. Cleveland Steele, ASCE Director from District 11 and former president of the San Francisco Section, recently went to Egypt to act as a consultant to the government on a study of the feasibility of placing a dam across the Nile River. Mr. Steele retired as vice-president of the Pacific Gas and Electric Co. in 1952.

D. B. Steinman, consulting engineer of New York City, has been awarded honorary degrees by several universities during the current commencement season: doctor of science in engineering, Sequoia University; doctor of science, Columbia University; doctor of laws, Alfred University; and doctor of engineering, Manhattan College, Rensselaer Polytechnic Institute and Ohio Northern University. Dr. Steinman was commencement speaker at a number of the universities honoring him.

Henry E. Helmboldt, lieutenant colonel, Corps of Engineers, North Pacific Division, at Portland, Oreg., is now serving as engineer in charge of construction for the Corps in Labrador.

Ford Kurtz has been elected president of the J. G. White Engineering Corp., of New York City, succeeding the late **Gano Dunn,** Hon. M. ASCE. Mr. Kurtz has been vice-president in charge of engineering since 1949 and was previously engineering manager and hydraulic engineer. He is a member of the executive committee of the U.S. Committee on Large Dams of the World Power Conference.

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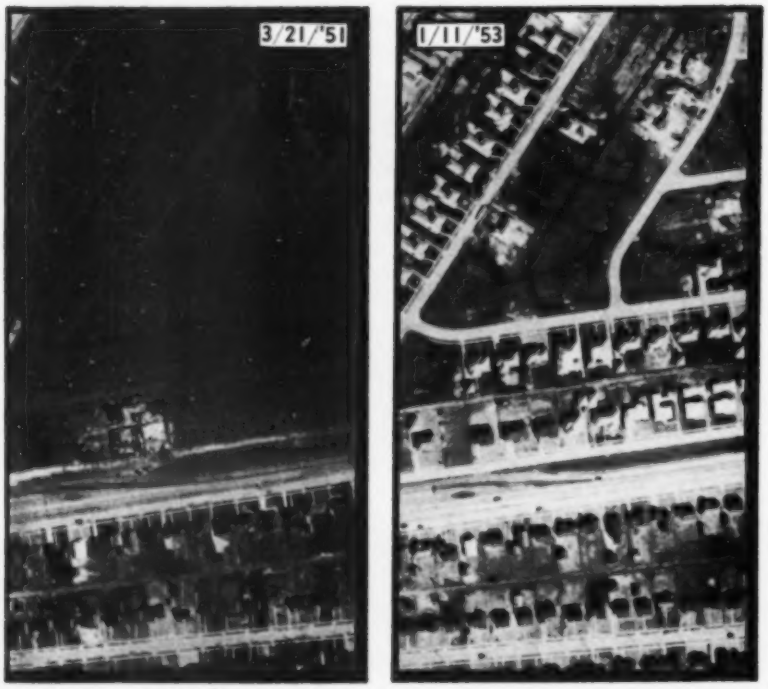

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Raymond C. Reese (left), structural engineer of Toledo, Ohio, receives the 1953 Award of the Concrete Reinforcing Steel Institute for "his contributions to reinforced concrete construction through design," from Prof. H. J. Gilkey, chairman of the award committee and head of the department of theoretical and applied mechanics at Iowa State College. The presentation was made at the Institute's 29th annual meeting at Pinehurst, N.C., on April 30. Mr. Reese is co-author of "Introduction to Reinforced Concrete Design" and author of the "C.R.S.I. Design Handbook."

Richard S. Holmgren, for several years assistant general manager and chief engineer of the San Diego County Water Authority, has been appointed general manager and chief engineer to fill the vacancy created by the recent death of **Joseph Burkholder.** Before joining the Authority in 1945, Mr. Holmgren was chief engineer of the New Hampshire Water Resources Board, assistant engineer for Boston's Metropolitan District Water Supply Commission, and was connected with other water supply systems in the New England area.

Richard Holmgren

R. H. Klucher, engineer in the construction department of the Dravo Corporation's machinery division, was awarded first prize of $500 in the 1952 annual technical papers competition sponsored by Dravo Corp. His paper describing the Elrama Power Station was presented before engineering groups at several colleges.

Paul G. Martin has resigned as highway planning engineer for the Kansas State Highway Commission to become a member of the staff of the Automotive Safety Foundation. Mr. Martin is currently serving as supervising engineer of the Foundation's Louisiana highway study.

G. L. McLane, who retired this year after 31 years of service as district engineer for the U.S. Bureau of Public Roads at Phoenix, Ariz., recently received a U. S. Department of Commerce Meritorious Service Award. Mr. McLane was president of the Arizona Section in 1948.

Lewis B. Moore is now associated with the New York firm of Knappen-Tippetts-Abbett-McCarthy in Korea. He retired recently after 32 years as director of supply and service for the Panama Canal.

G. M. O'Rourke, assistant engineer, maintenance of way, Illinois Central Railroad, was elected junior vice-president at the 52nd annual meeting of the American Railway Engineering Association held in Chicago.

Cushing Phillips, captain, CEC, USN, who is retiring with the rank of rear admiral, was honored at a formal dinner at the Officers' Club, Hunters Point, San Francisco, on April 24. In the Navy for 34 years, Captain Phillips has been on active duty in the Twelfth Naval District.

Thomas J. Sette, formerly executive officer of the 51st and 121st Seabee battalions and now in the Volunteer Reserves 3-41 of Hempstead, L.I., has been promoted to Lt. Commander, CEC, USNR. He is president of the Weniger & Sette Construction Corp., East Meadow, N.Y.

Charles A. Selby, assistant to the president of Vermilya-Brown Co., Inc., New York, N.Y., was recently elected president of the Metropolitan Builders' Association—the New York Chapter of Associated General Contractors. **W. J. Barney, Jr.,** executive vice-president and secretary of the W. J. Barney Corp., New York, is the newly-elected treasurer of the organization.

Dan E. Sewell, since 1927 associated with Thomas & Hutton, Engineers of Savannah, Ga., has opened his own office at 512 American Building in that city. Mr. Sewell is vice-president of the Savannah Subsection, which he served as secretary-treasurer last year.

Carl P. Vetter, chief of the Bureau of Reclamation's regional office of river control at Boulder City, Nev., for the past nine years, has taken an 18-month leave of absence to aid the Government of Iraq in the solution of river control and diversion problems on the Euphrates and Tigris rivers. While in Iraq he will be associated with the New York City consulting firm of Knappen-Tippetts-Abbett-McCarthy, which has been engaged in making investigations and preparing plans for dams and other structures there.

Edward J. Lupfer, of Buffalo, N.Y., designer of both the Peace and Rainbow bridges at Niagara Falls, has been honored by his alma mater, the University of Kansas, by election to the alumni rolls of the Lambda Chapter of Sigma Tau, honorary engineering fraternity. In 1944 he received the university's highest award, the citation for distinguished service. A former Director and Vice-President of ASCE, Mr. Lupfer is cur-

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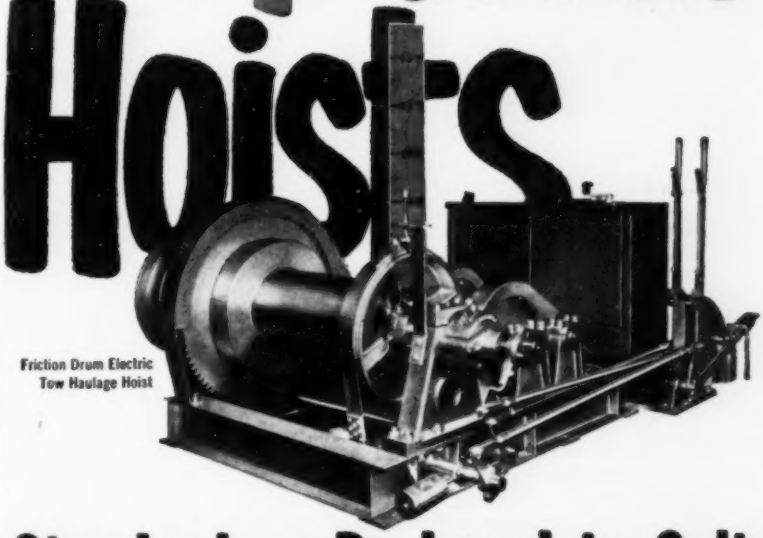

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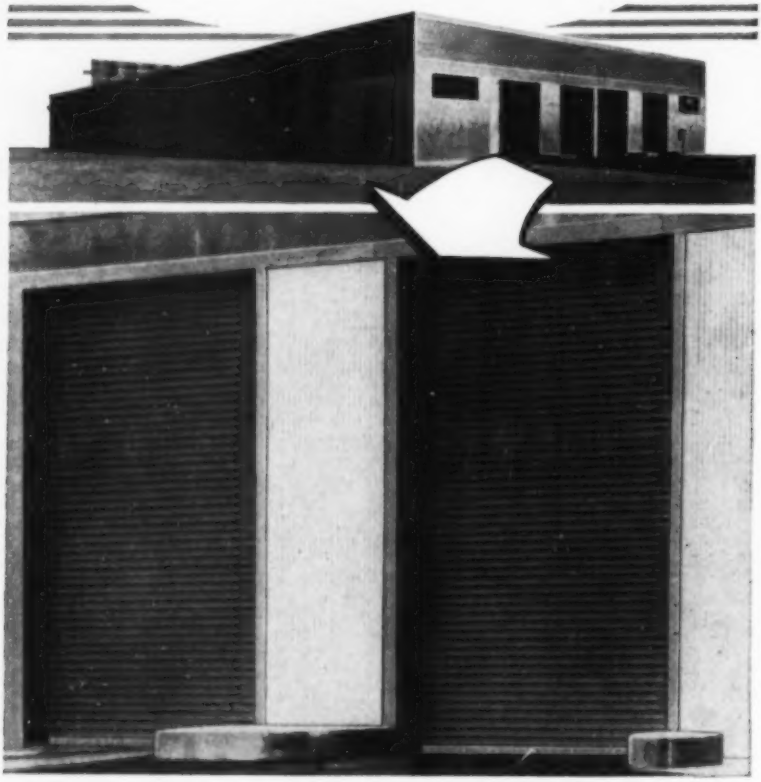

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Charles B. Spencer, president of the New York engineering firm of Spencer, White & Prentis, is this year's winner of the Egleston Medal—top honor of the Columbia University Engineering Alumni Association. The award, presented annually to a Columbia engineering graduate for outstanding achievement, was made at the 82nd annual dinner of the association. A member of the class of 1910, Mr. Spencer is president of the Columbia Society of Older Graduates and the General Contractors Association.

Charles B. Spencer

D. L. Cheney, vice-president of the South Birch Construction Co., Seattle, Wash., was recently elected to his third consecutive term as president of the Alaska chapter of the Associated General Contractors.

Lewis A. Pick, lieutenant general, USA, (retired), builder of the famed Ledo Road in World War II and the Thule Airbase, and former Chief of Army Engineers, has been elected vice-chairman of the Georgia-Pacific Plywood Co. He will maintain headquarters at the company's general offices in Olympia, Wash., upon completion of a 45-day tour of the firm's manufacturing plants and distributing warehouses.

James E. Mandry and **R. M. Raffelson,** lieutenant commanders, CEC, USNR, were recently awarded the Meritorious Service Medal of the Naval Reserve. In presenting the decorations, Rear Admiral L. N. Moeller, director of the Pacific and Alaskan Division of the Bureau of Yards and Docks, complimented the officers on their "contributions to the work of the office, interest in national defense and continued activity in the Naval Reserve."

Allen Wagner, for the past two years assistant to the chairman, U.S. Civil Service Commission, in Washington, D.C., has been appointed director of public relations of the National Jewish Hospital at Denver, Colo.

Clarence F. Maynard has retired after 22 years with the U. S. Coast and Geodetic Survey and is living on his farm near Unity, N.H. A veteran of World War II, Mr. Maynard was held prisoner by the Japanese from the fall of Corregidor until 1945. After the war he returned to duty with the Survey, and at the time of his retirement held the post of supervisor of the Coast and Geodetic Survey Computing Office in New York City.

Cornelius Wandmacher, head of the department of civil engineering at the University of Cincinnati, is a recipient of a newly instituted award for outstanding professional and civic leadership established by the Alumni Association of the Brooklyn Polytechnic Institute. A member of the class of 1933, Professor Wandmacher was on the faculty there from 1937 until 1951.

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Sand Cast	95,000	75,000	60,000	55,000	45,000	40,000
Rolled 1" and under	.....	75,000	65,000	60,000	50,000	45,000
Rolled or Forged, over 1"	.....	75,000	65,000	60,000	50,000	45,000
Elongation in 2"—%						
Sand Cast	10	12	14	15	20	25
Forged or Rolled	.....	12	15		15	20
Reduction in area—%						
Sand Cast	.....	12	14	15	20	25
Forged or Rolled	.....	12	15		15	20
COMPRESSION						
Yield Point—lbs. per sq. in.	70,000	65,000	58,000	50,000	40,000	35,000
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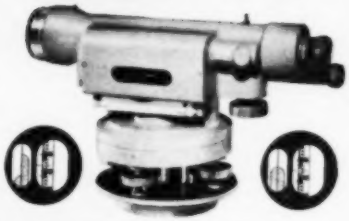

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RECENT BOOKS

Construction and Applications of Conformal Maps (Applied Mathematics Series, No. 18)

The thirty-two papers presented in this symposium cover a wide range of physical applications, chiefly with relation to electric machinery, electronic apparatus, mechanics, and fluid dynamics. Several papers also serve to introduce the mathematician to the use of high-speed calculators for the approximate solutions of problems. A bibliography of numerical methods in conformal mapping is included. (Edited by E. F. Beckenbach, National Bureau of Standards. For sale by the Superintendent of Documents, Government Printing Office, Washington 25, D.C., 1952. 280 pp., $2.25.)

Designing by Photoelasticity

The determination of stress concentrations is a necessary but difficult aspect of machine-part design. This book, by R. B. Heywood, provides a comprehensive treatment of the photoelastic method of stress analysis with emphasis on the engineering aspects. Part I covers basic information on the polariscope, photoelastic materials, the preparation and testing of models, and the application of model stresses to prototypes. A separate chapter is devoted to frozen-stress technique. Part II deals with specific stress concentrations in notches, holes, screw threads, bolts and nuts, and with the effective application of the procedure to improvement of designs. There is a large bibliography. (Chapman & Hall, Ltd., London, 1952. 414 pp., 65s.)

Durchlaufträger, Vol. II

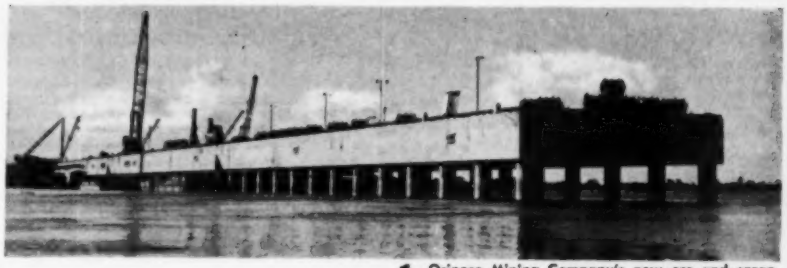
Volume II of this comprehensive work contains a complete theoretical development, ready-to-apply formulas, and numerical tables for continuous beams with special span reinforcement. Supplementary and concluding remarks to Volume I are also included. This revised edition (the seventh) has been enlarged to provide new material. The authors are Adolf Kleinlogel and Arthur Haselbach. (Wilhelm Ernst & Sohn, Berlin, 1952. 528 pp., DM 46.)

The Elements of Nuclear Reactor Theory

This volume—by Samuel Glasstone and Milton C. Edlund—presents the whole field of nuclear reactor theory and provides the engineer with the basic knowledge for an understanding of reactor technology. Based on lectures given at Oak Ridge, the book begins with the more elementary physical concepts and processes of nuclear reactions, and then develops at length the fundamental principles involved in the calculation of the critical conditions for chain reacting systems—including both homogeneous and heterogeneous reactors—giving detailed mathematical derivations. (D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N.Y., 1953. 416 pp., $4.80.)

Stabilizing Construction: The Record and Potential

In discussing the conditions that create instability in the construction industry the authors—Miles L. Colean and Robinson Newcomb—provide an analysis of the industry, its organization, methods, environment, and particular problems. They describe the characteristics of the products of construction and the demand for construction, cite costs, discuss the initiation and direction of the construction process, and point out the complexity of organization. The mutual effects of fluctuation in the construction industry and the general economy are taken up in detail as well as the differing motivations. The question of "cycles" is considered, with an appraisal of public works construction as an anti-cyclical device. On the basis of all these considerations, recommendations are



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offered for minimizing fluctuations in constructive activity, and a forecast is given of the probable market for construction. Nearly half the book is devoted to appendixes providing a large amount of basic data. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y., 1952. 340 pp., $6.)

Statically Indeterminate Structures

Three chapters of this work are devoted to evaluations of displacements and angles of rotation of strategic points and lines in beams and trusses, and three chapters to moment distribution. Single chapters deal with applications to statically indeterminate beams and trusses, the slope-deflection method, typical problems of design, haunched and tapered beams, wind-pressure analysis, and space structures. The appendix includes tables of parabolic haunches, straight haunches, and others. By Paul Andersen. (Ronald Press Company, 15 East 26th Street, New York 10, N.Y., 1953. 318 pp., $7.50.)

Introduction to Hydraulics and Fluid Mechanics

The author's intent is to provide a text which can be covered in the time allotted in an engineering curriculum, and yet include the topics most likely to be of use to engineers and to serve as an introductory course to advanced study. Approximately the first half of the book is concerned with basic material on fluid pressure, similitude, flow through pipes, flow in open channels, and dynamics of streams. The remainder deals with hydraulic machinery—pumps, the impulse wheel, reaction turbines—with the measurement of rate of flow, and with the fundamental aspects of compressible flow. The author is Jacob O. Jones. (Harper & Brothers, 49 East 33rd St., New York 16, N.Y., 1953. 403 pp., $6.)

Statically Indeterminate Structures

Thorough in treatment and development, this text for seniors and graduate students, by Chu-Kai Wang, covers the following topics: Finding deflections of statically indeterminate beams, rigid frames, and trusses; the analysis of statically indeterminate structures by the method of consistent deformation, by the three-moment equation, by the slope deflection and moment distribution methods, and by the method of column analogy. The analysis of fixed arches, secondary stresses in trusses with rigid joints, and composite structures are also treated. The effective coverage of basic principles and methods provides a useful reference work for the practicing engineer. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, N.Y., 1953. 424 pp., $7.50.)

The Steam Locomotive in America. Its Development in the Twentieth Century

This book, by Alfred W. Bruce, is devoted primarily to technical details of the steam locomotive as a form of prime mover. Following an introductory historical chapter, the author discusses the development of the locomotive generally, of power transmission, and of the basic elements of the locomotive, in the form of case histories. Also treated in like manner are the histories of some 60 individual types in the United States, with the origin, development, and present status of each. Separate chapters describe special-service locomotives and the competitors of the steam locomotive. In addition to detailed sketches there are photographs of 168 locomotive types. (W. W. Norton & Company, Inc., 101 Fifth Avenue, New York 3, N.Y., 1952. 443 pp., $7.50.)

Versuche Uber Die Widerstandsfähigkeit von Geschweissten Querträgeranschlüssen Bei Oftmals Wiederholter Biegebelastung, by Otto Graf and Versuche mit Ellira-Schweissungen by F. Munzinger (Berichte des Deutschen Ausschusses für Stahlbau, No. 17)

This publication of a German research committee on steel construction contains two reports: (1) A review of tests on the strength of welded cross-member connections under repeated bending load. It presents detailed results of tests to failure on nine types of connections between full-scale steel bridge I-girders of 60- and 30-mm depth. (2) A report on Unionmelt welds, giving a brief summary of a series of tests between 1939 and 1942 and detailed results of tests carried out between 1942 and 1944 at the Stuttgart Institute for Building Research. (Springer-Verlag, Berlin, 1952. 48 pp., DM 10.)

Wood Preservation

The aim of the authors—George M. Hunt and George A. Garrett—has been to summarize the essential facts on wood preservation and to provide a clear presentation of its fundamental principles. The various agencies of wood deterioration, wood preservatives, preserving processes and equipment, and the properties of treated wood are all discussed fully. Separate chapters deal with the economic aspects of preservative treatment and with fire-retarding treatments. Significant developments of recent years have been incorporated in the new edition. (McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York 36, N.Y., 1953. 417 pp., $7.50.)

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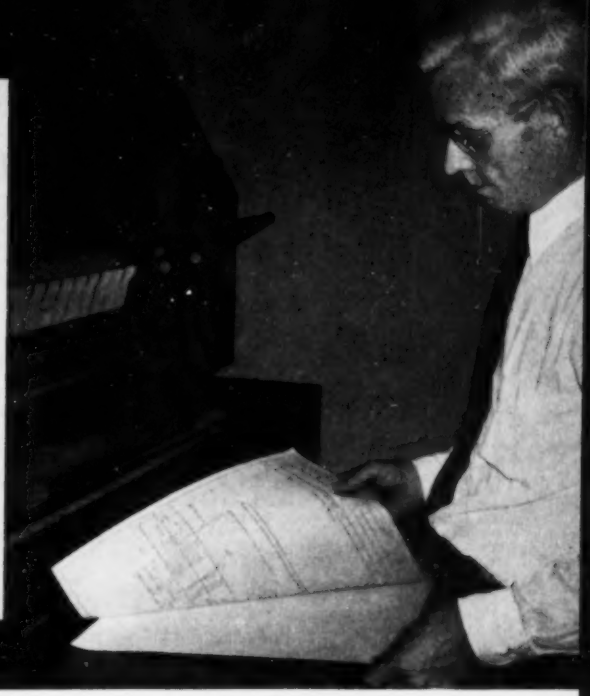

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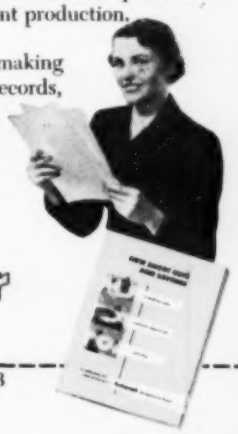

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CIVIL ENGINEER; J. M. ASCE; 24; married; B.S.C.E., University of Arizona, 1950. One year's experience in land leveling and subjugation; 2 years' experience Corps of Engineers, U. S. Army upon completion of present tour of duty, effective June 4, 1953. Desires to learn construction. C-844.

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FIELD ENGINEER, civil or mechanical graduate, with industrial building or heavy construction experience, to give line and grade, check equipment drawings and foundations, do cost work on chemical and refinery construction. Salary, $4,200 a year plus $7.50 per diem. Considerable traveling in United States. Y-8270.

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STRUCTURAL ENGINEER with 10 to 15 years' experience in reinforced concrete and structural steel design for electric utility work. Location, eastern Pennsylvania. Y-8331.

CIVIL ENGINEER, graduate, with 5 years' experience, or more, preferably in municipal field for engineering department. Salary open. Location, New Jersey. Y-8344.

DISTRICT ENGINEER, 30–45, civil or architectural with major in structural steel and personality to engage in sales promotion and public relations work with trade association. Some travel. Salary, $7,200 a year. Location, East or Midwest. Y-8367-D8343.

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FIELD ENGINEER for construction of a skyscraper type building. State past experience and salary requirements. Location, Florida. Y-8423.

INSTRUCTOR, young, in civil engineering, who is also able to teach mathematics. Must have a master's degree. Location, New England. Y-8436.

MUNICIPAL ENGINEER with experience in design and construction of sewers. Must be registered in Ohio or able to obtain registration. Starting salary, $5,000–$6,000 a year. Location, Ohio. Y-8505.

CIVIL ENGINEER for work in the mechanical department with duties consisting of some design drafting, office engineering and field supervision, and other work as assigned. Salary, $7,800 a year to start. Y-8507 (*a*).

FIELD ENGINEER with construction and plant engineering experience in beverage fields, to supervise installation and operation of bottling plants. Must speak Spanish. Salary, $6,000 a year plus expenses. Considerable traveling in South America. Y-8525.

STRUCTURAL DESIGNER C, 24–45, with at least 3 years' experience as indicated below. Should have 4 years' college or equivalent specializing in structural engineering. Will produce complete engineered designs of structural steel and concrete for industrial plants, machine pits and foundations, platforms, etc. Design and prepare working drawings from notes and sketches. Estimate cost of construction, steel and concrete work. Some traveling. Salary $3,750–$4,300 a year. Location, New Jersey. Y-8564 (*a*).

SALES ENGINEERS, 24–30, engineering degree desirable; previous sales experience not necessary. Established national concern selling prefabricated metal products to engineering and construction markets. Territory, mid-Atlantic States. Y-8588.

STRUCTURAL OFFICE ENGINEER, to analyze inquiries and projects, make structural layouts on specific jobs, to prepare estimates, furnish general engineering services to sales staff and distributors, to cooperate with the engineering and development departments. Salary $5,600 a year. Location, Midwest. Y-8618 (*a*).

FIELD ENGINEER, civil, architectural or industrial engineer; 25–35; with at least 1 year's experience in construction work. To supervise field operations in construction and maintenance work on small buildings. Salary, $4,800 a year. Considerable traveling—car required. Employer will pay fee. Location, Michigan or Ohio. T-9818.

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Senior and General Sanitarian, State of Washington. Applications are being accepted continuously by the State of Washington for the position of general sanitarian at a salary ranging from $301 to $358 a month, and for senior general sanitarian at $328 to $391. A written examination will be given to those who fill the basic requirements—bachelor of science degree for both positions and two years of experience for that of senior sanitarian. Applications and information are available from the State Personnel Board, 1209 Smith Tower, Seattle 4, Wash.

Draftsmen, Township of North Bergen, N.J. The Township of North Bergen, Hudson County, N.J., plans to employ several undergraduate engineering students this summer as draftsmen on the preparation of a new assessment map. First preference will be given to residents of North Bergen and second preference to residents of New Jersey. Further details are available from Joshua Muss, Township Engineer, 4233 Hudson Boulevard, Township of North Bergen, Hudson County, N.J., or by calling Union 3-8500.

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New Publications

Culvert Inlet Design. Studies of the importance of inlet design on culvert capacity—conducted at the St. Anthony Falls Hydraulic Laboratory and presented at the 32nd annual meeting of the Highway Research Board—have been made available in preprint form by the University of Minnesota. Authors of the paper are Lorenz G. Straub, Alvin G. Anderson, and Charles E. Bowers. Inquiries concerning the report, identified as Technical Paper No. 13, Series B, should be addressed to the St. Anthony Falls Hydraulic Laboratory, University of Minnesota, Minneapolis, Minn.

Atomic Energy. A summary of the atomic energy program of the United States has been made available by the Nuclear Energy Applications Committee of the American Society of Mechanical Engineers in a 50-page illustrated pamphlet, entitled *Uranium, Plutonium and Industry*. A revision and enlargement of an earlier booklet called *Catching Up on Atomic Energy*, the present publication is available from the ASME, 29 West 39th Street, New York, 18, N.Y. The price is $1.50 for single copies and 60 cents for lots of 100 or more.

School Building Costs. In response to the $10 billion need for schoolhouse construction, only half of which can be met by local community funds, the Building Research Advisory Board sponsored a Conference on School Building Costs during the past fall. The results of the conference, which attempted only to delineate the areas of research to be covered, are reported in a recent BRAB publication entitled *School Building Costs*. Copies, priced at 50 cents each, may be obtained from the BRAB, 2101 Constitution Avenue, Washington, D.C.

Air Pollution. Two new four-page folders on air-pollution problems are available, at 10 cents each, from the Office of Information Services, New York University College of Engineering, New York 53, N.Y. One, entitled "Wind Tunnel Techniques Used to Study Influence of Building Configuration on Stack Gas Dispersal," was prepared by Gordon H. Strom, associate professor of aeronautical engineering. The other, "Air Pollution Surveys," was written by William T. Ingram, associate professor of public health engineering and secretary of the N.Y.U. Air and Water Pollution Research Section.

Hydrology Bibliography. Availability of a bibliography of all known hydrologic literature published in the United States and Canada between 1941 and 1950 is announced by the Chief of Engineers in behalf of the Subcommittee on Hydrology of the Federal Inter-Agency River Basin Committee. Entitled *Annotated Bibliography on Hydrology*, the report was compiled by the American Geophysical Union under the auspices of the Subcommittee on Hydrology and has been issued as Bulletin No. 5 in "Notes on Hydrologic Activities." Copies are available from the Superintendent of Documents, Washington 25, D.C., at $1.75 each.

Highway Engineering. The Proceedings of the 1952 Ohio Highway Engineering Conference—held at Ohio State University in April 1952 under the direction of the Department of Civil Engineering and the Ohio Department of Highways—have been made available as Bulletin No. 150 of the Engineering Experiment Station. Copies are $1 each, and requests should be addressed to the Director of the Station, Ohio State University, Columbus, Ohio.

Engineering Bibliography. A supplementary list of publications of the National Bureau of Standards from July 1, 1947, to June 30, 1952, has been issued by the Bureau as a Supplement to its Circular 460. The 223-page list sells for 75 cents, upon application to the Government Printing Office, Washington 25, D.C.

Nuclear Power Reactor Technology. Availability of a booklet containing the declassified versions of reports made to the Atomic Energy Commission by four separate teams of non-governmental industrial representatives (see item, page 79), who spent a year inside the atomic energy program appraising the prospect for private industrial participation in joint production of electric energy and fissionable

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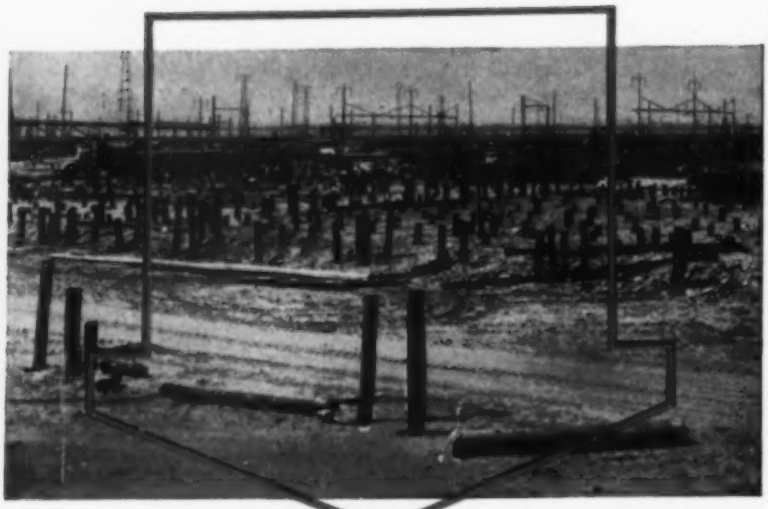

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material from reactors, is announced by AEC. The declassified versions were prepared by two members of the Commission's Advisory Committee on Industrial Information—Andrew W. Kramer, editor of *Power Engineering*, and Stanley A. Tucker, manager of publications for the ASME. Copies of the booklet, priced at 25 cents, may be obtained from the U. S. Government Printing Office, Washington 25, D.C.

Consulting Engineers Periodical. Issuance of a monthly magazine, edited with the special interests of consulting engineers in mind, is announced by the Industry and Power Publishing Company, of St. Joseph, Mich. Called *Consulting Engineer*, the publication will be directed by name and title to more than 7,000 consulting engineers throughout the United States on a controlled circulation basis. Three general types of editorial material will be treated in each issue—engineering and technical information, management and operation, and industrial economics.

Pollution Control. Six sewage treatment plants, completed and placed in operation in the Interstate Sanitation District (New York, New Jersey, and Connecticut) in 1952, are described in the recently issued report of the Commission. Inquiries concerning the 40-page illustrated report should be addressed to the Interstate Sanitation Commission, 110 William Street, New York 38, N.Y.

Pollution Control. *Reducing Phenol Wastes from Coke Plants* is the title and subject of another manual in the industrial waste treatment series being published by the Ohio River Valley Water Sanitation Commission. Compiled by representatives of the major steel companies in the area who serve in an advisory capacity to the Commission, the 36-page illustrated publication describes a variety of process changes and treatment methods that have proved practical in handling phenol-waste problems. Copies, priced at $1, may be obtained from the Ohio River Valley Water Sanitation Commission, 414 Walnut Street, Cincinnati 2, Ohio.

Solution to problem on page 61

Relief of excess pressure was provided for by the construction of an air chamber approximately 12 ft from the pump. The air chamber was made from a boiler, 8 ft in diameter and 18 ft long, that had been discarded from a sugar mill. The tubes and one baffle plate were removed and tube holes in the remaining baffle plate were covered by a $\frac{1}{2}$-in. steel plate fastened by bolts. The unit was made air tight by welding and placed in an upright position on a concrete foundation in which was molded a section of the 26-in. line.

The height that water would rise in the chamber was predetermined for both normal and excess pressures. For observation, a gage glass was placed on the side of the chamber to include this range of possible rise and fall. Also, for observation, a gage of 150-lb capacity was installed on the chamber. During a power failure, 27 pressure surges were observed and recorded.

After seven days of operation it was noted that a slight vacuum had been created. The chamber was brought back up to atmospheric pressure by opening a $\frac{1}{4}$-in. valve that had been installed for this purpose.

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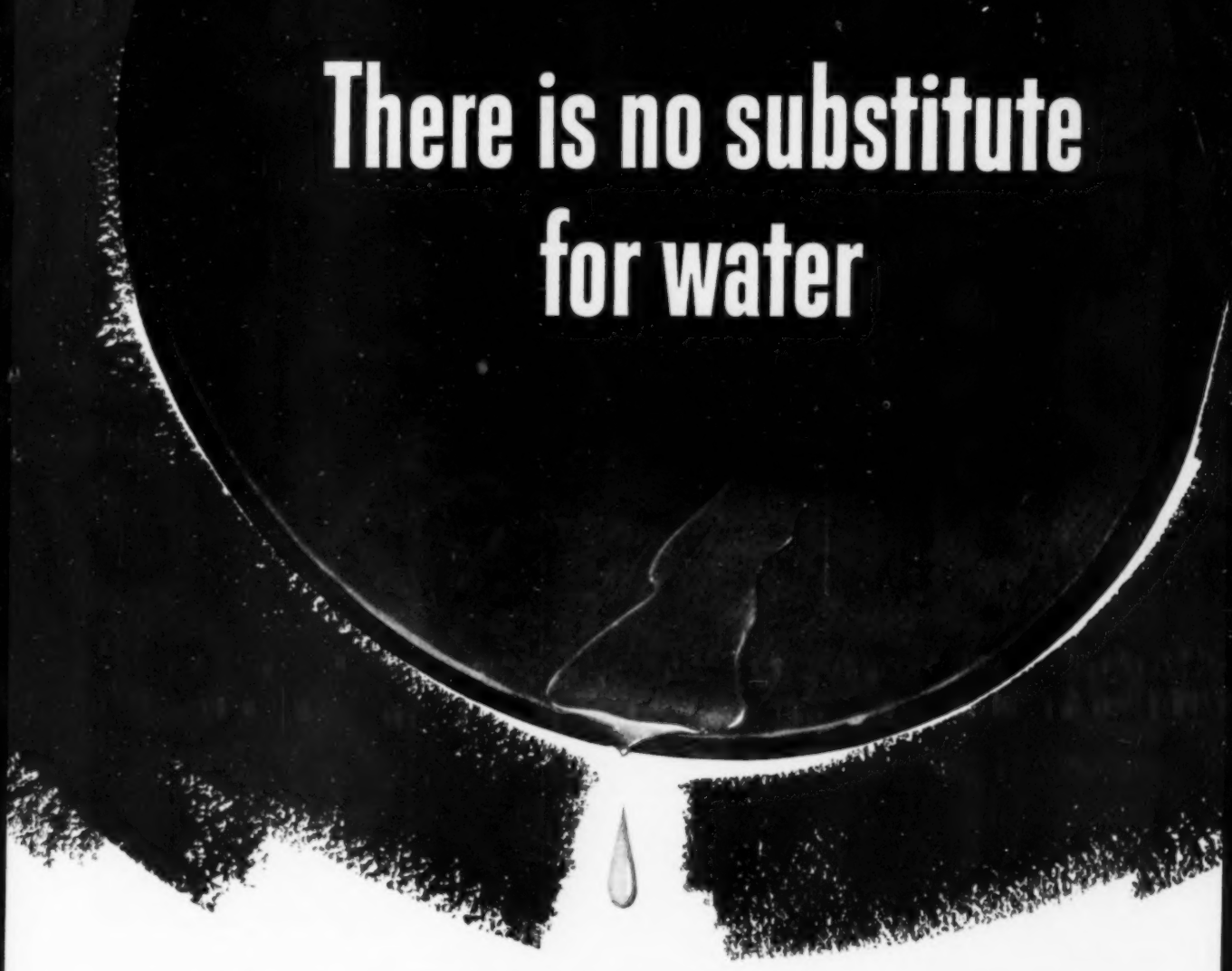

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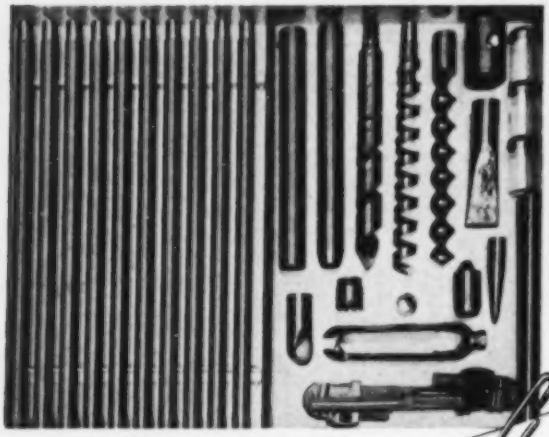

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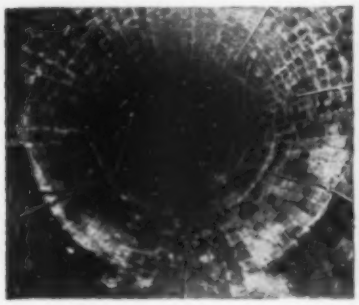

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Non-ASCE Meetings

American Institute of Electrical Engineers. A program covering advances in the electrical field, from tiny transistors to gigantic generators, will feature the summer general meeting of the American Institute of Electrical Engineers to be held at the Chalfonte-Haddon Hall, Atlantic City, N.J., June 15–19.

American Society for Engineering Education. The underlying theme of the 1953 annual meeting of the American Society for Engineering Education, to be held at the University of Florida, Gainesville, June 22–26, will be a broad evaluation of the job that the engineering colleges perform.

American Society of Heating and Ventilating Engineers. The American Society of Heating and Ventilating Engineers will hold its 1953 semi-annual meeting at the Shirley-Savoy Hotel, in Denver, Colo., June 29–July 1.

American Society of Mechanical Engineers. Headquarters for the semi-annual meeting of the American Society of Mechanical Engineers will be the Hotel Statler, Los Angeles, Calif., June 29–July 2.

American Society for Testing Materials. The 56th annual meeting of the American Society for Testing Materials will take place at the Chalfonte-Haddon Hall, Atlantic City, N.J., June 28–July 3. The program includes eight technical symposiums and an estimated 600 meetings of various ASTM technical committees.

Conference on Modern Highways. As part of the 1953 summer session of the Massachusetts Institute of Technology, the Departments of Civil and Sanitary Engineering, and City and Regional Planning, and the Massachusetts Department of Public Works, are jointly sponsoring a Conference on Modern Highways on the M.I.T. campus, Cambridge, Mass., June 23–25.

Conference on Soil Stabilization. Examination of current problems in stabilization treatment will be featured at a three-day Conference on Soil Stabilization at the Massachusetts Institute of Technology, June 18–20. Sponsoring the conference with M.I.T. are the Navy Bureau of Yards and Docks; the Army Corps of Engineers; the Highway Research Board; the Massachusetts Department of Public Works; and the U. S. National Council on Soil Mechanics and Foundation Engineering.

Conference on Road and Street Traffic Control. A conference on road and street traffic control will be held at Purdue University, West Lafayette, Ind., June 22–24.

Third International Congress on Soil Mechanics and Foundation Engineering. The first part of the Third International Congress on Soil Mechanics and Foundation Engineering will be held at Zurich, Switzerland, August 16–21. Following a four day trip through Switzerland (August 22–25), the Congress will hold its final session at Lausanne on August 26. All correspondence relative to the Conference should be addressed to Dr. I. von Moos, General Secretary, Gloriastr. 39, Zurich 6.

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NAHUL BENEVOLO, Rio de Janeiro, Brazil.
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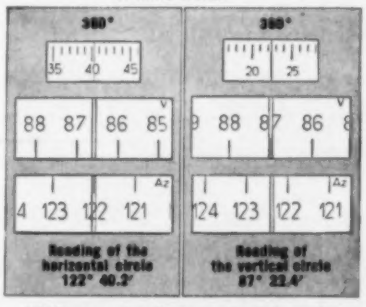

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EQUIPMENT, MATERIALS and METHODS

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COMPLETELY ODORLESS paints in every interior finish and in a full selection of colors is the latest development in the decorating field and should prove to be a boon to establishments where the presence of obnoxious paint odors is disturbing to those who occupy or visit the premises as well as harmful to merchandise. Every interior surface may now be painted while people are in the same room, if that is feasible. If space limitations or other considerations make this impractical, it is possible to use the room immediately after painting, or within the few hours necessary for the surface to dry, without any trace of paint odor. **Keystone Paint and Varnish Corporation, Brooklyn, N. Y.**

Hydraulic Outriggers

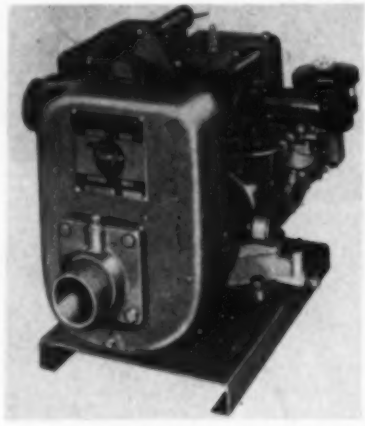
HYDRAULICALLY-OPERATED outriggers are now available as optional equipment on the Model B Pitman Hydra-Lift, truck-mounted crane with loadline capacity of 6400 lbs and power-swinging boom which telescopes from 12 to 22 ft. With the outriggers hydraulically powered, an operator can raise and lower the outrigger legs instantly simply by manipulating controls at his regular operating station. This makes it possible to speed up greatly any job where outriggers must be used frequently;

Model B Hydra-Lift

such jobs as stringing pipe, pulling paving forms and unloading materials at a number of different points around a job site. Hydra-Lift, which has been on the market about 2½ years, requires but 40 in. behind the cab of a truck, leaving the balance of the chassis for normal hauling purposes. Hydraulic power swings the boom 180 deg, lifts it through an arc of 100 deg. This compact, versatile crane, has proved a time and labor-saving tool for handling gas, water and sewer pipe, paving forms, structural steel, building materials, poles, transformers, precast concrete and many other similar loads. Because they are so easy to operate, the hydraulic outriggers constitute an important safety feature, as the operators don't try to get by on "border-line" loads without first putting outriggers down. **Pitman Manufacturing Co., 300 W. 79th Terrace, Kansas City, Mo.**

Contractors Pumps

A LINE OF all-purpose, heavy duty Contractors Pumps has been developed. The gasoline engine equipped pumps are available in many models and sizes. The Model 675, a 1-1/2 in. pump, has a 1.5 hp engine and is capable of heads to 90 ft and has a capacity of 6600 gph. The Model 676, a 2 in. pump, has a 1.9 hp engine for discharge heads to 100 ft and has a maximum capacity of 8300 gph. Some of the major features of the line are truly self-priming performance, rugged construction and solid one piece base, large priming plug and thoroughly reliable mechanical seal. **Lancaster Pump and Manufacturing Co., Inc., Lancaster, Pa.**



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Gradall Carrier

THE GRADALL, multi-purpose earth-mover and construction machine, is now being supplied with a new undercarriage specifically designed for maximum operating efficiency of the unit as a whole. The carrier provides the ideal balance for Gradall operation, distributing the load in reference to the frame so that the entire unit is tip-proof without the need for outriggers. At the same time, the carrier's wheel base is 18 percent shorter than has hitherto been available, making for maximum maneuverability. Wheel base is now 162 in., carrying a frame 244-1/4 in. in overall length. With a chassis weight of 12,550 lbs the carrier is the heaviest ever to be used for Gradall mounting. The frame is ruggedly constructed of extra-heavy 8 × 10 in. H-beam having a section modulus of 40 lbs. Gross vehicle weight is 40,000 lbs. The engine used in the new undercarriage is a 427 cu in. L-head unit developing 140 hp at 2800 rpm. An oversize radiator is used to insure ample cooling even when running idle at high ambient temperatures. A 13-in. vibration-dampened clutch is incorporated in the design, as are Timken axles and Bendix-Westinghouse air brakes. Available for the first time as an optional accessory is a remote control carrier drive system making possible one-man operation of the Gradall. By means of pushbuttons in the upper cab,

Features Shorter Wheel Base

the operator may actuate a pneumatic-electrical control system which gives him complete control of the carrier. **The Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio**

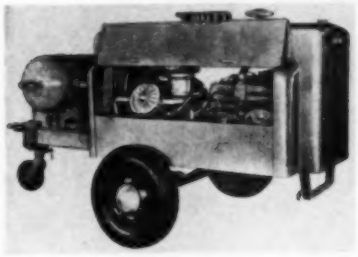
Jaw Crushers

A LINE of jaw crushers to be known as the Lippmann Rock-Ram crusher is announced. This machine is a fabricated type and contains the mechanical features that have made its partner the Lippmann Grizzly-King crusher famous for capacity and service. The Rock-Ram will be available in sizes 10×16, 10×20, 10×24, 10×36, 15×36, 20×36 and 30×36. **Lippmann Engineering Works, 4603 W. Mitchell St., Milwaukee 14, Wis.**

Equipment, Materials & Methods (Continued)

Compressor

A 210 CFM compressor of high speed 2-wheel trailer design is announced. Known as Super Chief Model 210-WDS, the unit is said to be the lightest, most compact compressor ever built of this capacity. It is 145 in. long, 62 in. high and 75 in. wide. The weight is 3400 lbs. The compressor unit is of W series design and is equipped with newly-developed Davey Multi-Port valves. Use of these valves increases by 15 to 25 percent the amount of air delivered per lb of fuel. In addition, valves are reputed to never carbon or foul and to



Model 210-WDS

operate at peak efficiency during the life of the compressor. Engine is of Hercules 6 cylinder design with a power surplus of over 25 percent. **Davey Compressor Co., Kent, Ohio**

Protractor

A NEW CONCEPT in adjustable, engineers protractor design and adaptability has been announced. Called the Tractograf, it is a miniature drafting machine in itself. This precision instrument will be of unusual interest to engineers, draftsmen, architects, artists and students. Any number of angles, from zero to 180 deg can be drawn instantly without turning, sliding, or moving the protractor out of position at any time. Simply swing upper rule arm to desired angle and lock adjustment knob. A magnifier, built-in over the registration mark, gives clear, hairline adjustment every time. Dial is white and easy to read. The 180 deg arc is calibrated in sharply defined 1 deg and 5 deg divisions. In addition, usually forgotten but often needed mathematical formulae are printed on the reverse side of the calibrated dial. A handy 5 in. rule on the lower arm is also an added convenience. The Tractograf is made from clear, lifetime plastic with smoothly machined and bevelled ruling edges for fast and accurate work. Two in. wide and seven in. long when set at zero, it is handy for shirt or coat pocket. **Way-Mac Mfg. Co., 8112 Melrose Ave., Los Angeles 46, Calif.**

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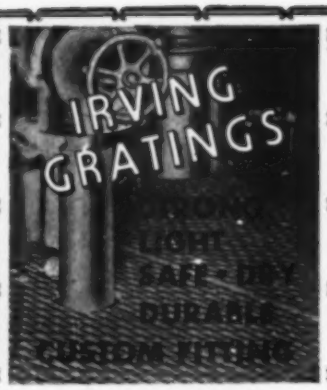

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Equipment, Materials & Methods (Continued)

Recording Camera

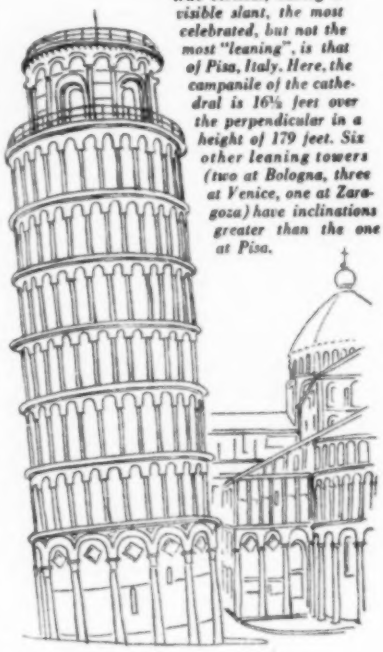
A COMPACT, LIGHT-WEIGHT, and inexpensive recording camera, the Auto Camera Mark 3, is announced. Originally designed for aircraft use, it is finding application to a very wide range of scientific, engineering, and industrial applications. Many accessories are available to permit its use for time-lapse recording, photomicrography, normal and stereo photomacrography, aircraft instrument recording, chemical experiment recording, traffic and highway condition recording and the like. Photography may be automatically accomplished to speeds as fast as 4 pictures per sec or at intervals from $^1/_4$ sec to as long as desired. In this way, any number of events may be recorded over relatively long periods of time. The Auto Camera Mark 3 is fully automatic in operation. A special spring motor provides, with one winding, the exposure of 21 ft of 35-mm film held in special cassettes. Both the exposure and film transport functions are effected by a single electrical pulse. **J. A. Maurer, Inc., Photographic Instrumentation Div., 37-01-31st St., Long Island City 1, N. Y.**

Dump Truck

PRODUCTION of the M-310 dump truck, featuring important innovations and improvements in dump truck design, has been announced. Outstanding features of the truck are greater payload capacity and easy maneuverability on the highway and on the job. Both these features result from the fact that the M-310 is not merely a modification of a standard truck and chassis, but is designed and engineered throughout exclusively for dump service. To increase total legal payload capacity, greater advantage has been taken of the load-carrying ability of the front axle, by shifting a portion of the payload weight to the front. A rugged, heavy-duty front axle has been provided to absorb this greater weight, with safety margin to spare. The chassis is built of high quality steel members, braced to support a maximum load. All component parts of engine, steering mechanism, axles, transmissions, and drive units are built for rugged service, are easily maintained, and readily replaced from stocks available at local parts dealers everywhere. The powerful Ford 317-V-8 overhead valve, 155 hp engine is easily accessible for service and repair, simply by elevating the sturdy one-piece steel hood. The wheel base length of the unit is 174 in., centerline to centerline. The truck is equipped with Cook Bros. hydraulically powered telescopic hoist. Safe, simple, and reliable in operation, the hydraulic principle eliminates heavy mechanical levers, arms, cams, and other parts subject to wear and failure. A simple arrangement of telescoping sleeves, hydraulically actuated, make up the basic hoist mechanism, **Cook Bros. Equipment Company, 1815 N. Broadway, Los Angeles, Calif.**

An interesting slant on Pisa!

Of the many towers which are out of the true vertical, having a visible slant, the most celebrated, but not the most "leaning", is that of Pisa, Italy. Here, the campanile of the cathedral is 16½ feet over the perpendicular in a height of 179 feet. Six other leaning towers (two at Bologna, three at Venice, one at Zaragoza) have inclinations greater than the one at Pisa.



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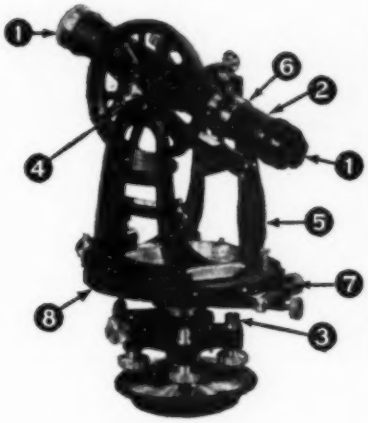

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Equipment, Materials & Methods (Continued)

Front End Loaders

TWO 4-WHEEL planetary drive, 4-wheel power steering front end loaders, the Scoopmobile Models LD5 and LD10, are announced. Featuring an entirely new development in smooth, flexible power, these Scoopmobiles employ a new principle of construction by hinging two power axle elements together with an oscillating center-pin steering coupling. This coupling

Model LD5 Scoopmobile

allows an oscillating twist to the axles, retaining full power on all 4 wheels in any degree of the turning radius. Power from engine is transmitted to all 4 wheels through 3-to-1 planetary gearing, producing positive traction and tremendous "dig in" power. Hydraulically operated loading bucket has exceptional "break out" action resulting in better and faster loading. Hinged coupling steering allows excellent lateral spotting of bucket. Discharge height of the LD5 is 8 ft 6 in.; the LD10 is 9 ft. Reversing transmission has 8 speeds forward and back. Diesel power optional at extra cost. Pneumatic tires eliminate maintenance and expense of crawler tracks, permit highway travel. Weather tight operator cab has safety glass and windshield wipers. The versatile Scoopmobiles can be used for handling aggregate, loading coal and ore or any bulk material. **Mixermobile Manufacturers, 8027 N. E. Killingsworth St., Portland 20, Ore.**

Rust Preventive Paint

TO SAVE THE cost of chipping rust away, paint metal with S.R.P. (Sure Rust Prevention), a unique rust inhibiting paint. Tests by independent laboratories prove S.R.P. outlasts red lead, yet costs 1/3 less. Rust prevention has always been cheaper than rust damage, now S.R.P. cuts the costs of rust prevention. Take a metal structure that is already heavily rusted. The painter simply wire-brushes the heaviest rust scale away, then paints. The S.R.P. penetrates the rust, goes right down to the base metal, chemically inhibits further rust formation. In factory after factory, S.R.P. outlives red lead, even where exposed to acids, alkalies, or salts. It won't crack as the metal expands and contracts. **Dept. P-5, L. Sonneborn Sons, Inc., 80 8th Ave., New York 11, N. Y.**

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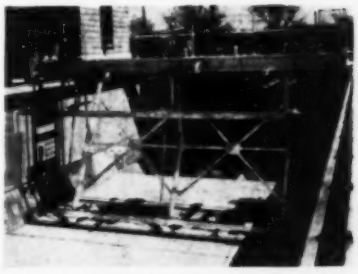

Particularly suitable where space is limited or where sludge delivery is desired at one end of tank. Consists of a bridge crane spanning width of the tank, supporting sludge scraper and skimmer, which moves automatically back and forth.

Many of these units are now operating in sewage plants throughout the country.

This unit has also proven highly successful as an oil-water separator in the treatment of oil refinery waste water. Bulletin 31-D-37.

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ECONOMY METAL FORMS

Equipment, Materials & Methods (Continued)

Compaction Roller

A 100-TON compaction roller with advanced yoke design is announced. Rolling on 44-ply 2100 × 25 tires with a rated load per tire of 53,000 lbs, this big unit features four unitized weight boxes. Each box can rise and fall 12 in. to follow uneven ground. The large diameter steel tubing

Advanced Yoke Design

yoke is constructed in sections to permit the use of three to six weight boxes, each riding on its own tire and each free to rise and fall independently of the others. A new feature is the manner in which inside beams are full-circle welded to the yoke, instead of being bolted in place. This prevents torsional weaving and simplifies rearrangement of the weight boxes as required by varying ground conditions. On gravels, medium clays and silts, a maximum compaction of 6 to 12 in. lifts is reached with only four to six passes. Southwest also manufactures this oscillating compaction roller in 15, 25, and 50 ton sizes. **Southwest Welding & Manufacturing Co., Alhambra, Calif.**

Corrosion Prevention

THE LONG-LASTING corrosion resistant qualities of pure metallized zinc and aluminum coatings are well known. Life expectancies for protective coatings of this nature, properly applied, range upwards of 20-30 years without further attention. The Metco Systems, a new series of 18 basic engineering specifications developed by Metallizing Engineering Co., Inc., cover the protection of structures and equipment under a wide range of corrosion conditions, including immersion in salt or fresh water of various pH values; exposure to water ballast, condensate and some mild acid solutions, and to salt, humid, rural and industrial atmospheres ranging from light to heavy. The Metco Systems are the result of over 19 years' experience with pure zinc and aluminum coatings on many different types of structures and equipment. They provide the answer to standardization of surface preparation, coating thickness for various service conditions and after-coatings to meet specific requirements. The Systems also provide for meeting appearance requirements with specific organic coatings in a range of colors, all thoroughly tested for compatibility with the metallized zinc and aluminum. **Metallizing Engineering Company, Inc., 38-12 30th St., Long Island City 1, N. Y.**

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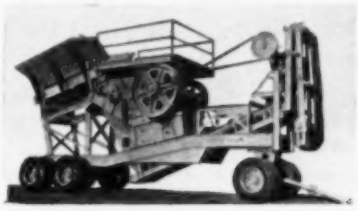
Equipment, Materials & Methods (Continued)

Scaffolding

A TUBULAR STEEL scaffolding drastically cuts time and labor for scaffolding users, according to an announcement. The scaffolding is ideally suited for major construction projects and for use by bricklayers, masons, carpenters, roofers, etc., because of its simplicity and speed of assembly. The scaffolding, known as Jagiel "Kwik-Skaf", has only two basic parts: frame and tie-bar. A unique slip-fit eliminates bolts, pins or screws. The scaffolding has been load-tested by independent laboratories at better than 400 lbs per sq ft. The compact design also simplified the storage problem and permitted quick transportation and easy handling on the job. Where many conventional scaffolds are difficult to break down or move about, Kwik-Skaf can be quickly dismantled, transported and erected. The compact design permits stacking in a small space and simplifies transportation. On the job, the scaffolding need not be dismantled in going from one area to another. **Brainard Steel Div., Sharon Steel Corp., Warren, Ohio**

Crushing Plant

A PORTABLE PRIMARY crushing unit, Model AAA-GR, has been completely redesigned from previous Cedarapids models to incorporate a vibrating grizzly to act as a by-pass for materials under crushing size. The design reduces the load on the



Model AAA-GR

jaw crusher, and insures larger crushing space, higher capacity and lower maintenance. Model AAA-GR retains all the features of previous Cedarapids models, but has been improved with additional refinements in design and construction. The outstanding feature of the unit is the vibrating grizzly which eliminates dirt and fines from material before they reach the crushing chamber. Material passing through the grizzly bars drops into the by-pass chute and discharges onto the under-crusher conveyor which carries it to the next crushing unit. Use of the vibrating grizzly makes the Model AAA-GR especially effective for obtaining peak production in gravel and quarry operations where a high percent of the raw material is below the 2-1/2 in. to 6 in. range of size, depending upon the finished product size desired. **Iowa Manufacturing Company, Cedar Rapids, Iowa**

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Equipment, Materials & Methods (Continued)

Arc Welding Head Shield

AN ARC WELDING head shield designed specifically for operator comfort has been announced. It is called the Lincoln Comfort-Shield. The feature of the shield is a permanently pliable head band made of plastic rather than the usual fibre. The adjustable plastic head band fits the head in the same way a hat does, giving a firm but comfortable fit throughout the day. The band is adjustable to fit both around and over the head, and can be put on with one hand. The plastic does not dry out and curl up as does fibre, but remains soft and pliable. The shield proper is made with one piece molded fibre construction which results in both light weight and strength. It has wide and deep clearance around the head to permit free circulation of air. The normal chin strap has been eliminated. Adjustable stops on each side of the head band limit the drop of the helmet to any point desired by the welder. The stops prevent the shield from hitting the nose or chin when welding vertical or overhead. **The Lincoln Electric Co., 22801 St. Clair Ave., Cleveland 17, Ohio**

Waterproofing Compound

FULL-SCALE production of Drycrete, a cement additive for integral waterproofing, was announced. Drycrete, which is a non-water-soluble liquid, will make cement, concrete or stucco waterproof when dispersed throughout the mix. It is especially recommended for use in new construction, both in parging and mortar, for foundations, walls inside and out, concrete bridges, etc. The low cost of adding the Drycrete to cement was more than overcome by the elimination of call-backs for builders on basements and cellars, and by the fact that Drycrete plaster, applied in a single coat, was more effective than two or three coats of ordinary plaster. Other Drycrete properties include positive bonding to block or brick, without the need for lath or furring on inside walls; paintability; reduction of shrinkage and cracking; and easier working for the mason. **Shield Chemical Corporation, 251 Grove Ave., Verona, N. J.**

Lift Trucks

TWO COMPLETELY new fork lift trucks in capacities of 3,000 and 4,000 lbs have just been released. They are the Models YC-40 and UC-30, powered by heavy-duty, water-cooled industrial engines and mounted on cushion-type tires. Outstanding features are their extreme compactness, durability and maneuverability. The very latest in lift truck engineering, the YC-40 and UC-30 were functionally designed for appearance as well as efficiency. The YC-40 has a capacity of 4,000 lbs at 24-in load centers. Its narrow width of only 38 in. and short overall length of 78-1/2 in. permit it to operate

(*Continued on next page*)

with speed and efficiency inside of boxcars and in crowded quarters. Its low collapsed height of only 82-1/2 in. permits it to pass through ordinary doors and under low ceilings. The load can be raised 30 in. before the minimum height is affected. Ample underclearance allows safe travel over rough surfaces and inclines. The YC-40 will climb a 20 percent grade loaded or empty. The UC-30 is basically the same truck as the YC-40, but with 600 lbs less counterweight and a capacity of 3,000 lbs at 24 in. load centers. The overall length is only 74-3/8 in. and it will climb a 24 percent grade loaded or empty. Both trucks have a sharp turning radius of 75 in. and 30 in. of free lift on the standard 9-ft uprights. Other features include heavy duty brakes, simplified automotive-type controls, quick-change clutches and readily accessible service points. **Hyster Company, 2902 N.E. Clackamas St., Portland 8, Ore.**

Trencher

THE MODEL 88 Trenchmobile recently completed extensive tests in more than 50 cities throughout 28 states. This machine was tested under some of the most adverse digging conditions by excavating over 75,000 lineal ft of trench in depths up to 5 ft and from 8 to 12 in. wide. The operation of the four cylinder Hercules gasoline engine Model JX4C5 was checked

Model 88 Trenchmobile

carefully throughout the testing. This power unit, as installed in the Parsons Model 88 Trenchmobile, develops 43.6 hp at 2,000 rpm. During tests, regular periodic changes of crankcase oil and oil filters were made. This periodic inspection was the only maintenance necessary throughout the entire test. In addition, the records kept on this test, showed very low fuel consumption. This means less down time and lower operating costs; welcomed assets to any successful contractor. **The Parsons Company, Newton, Iowa**

CORRECTION, PLEASE

In the item, "Building Material" on page 116 of the May issue, the statement, "it is combustible" was made. As any product made from sand and cement can hardly be combustible, the word should be corrected to read "incombustible."

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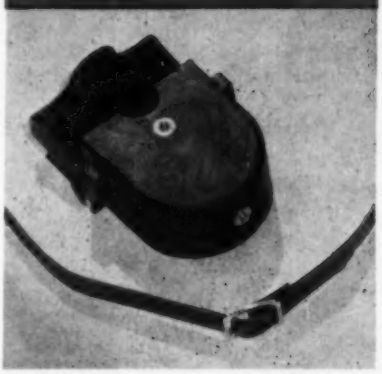

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TIDE GATES

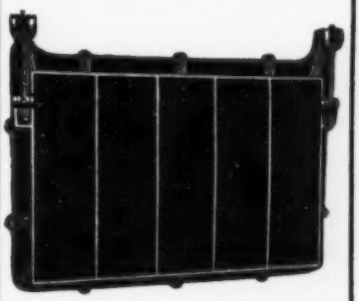

Fig. B-61. Type M-M

Type M-M (Rectangular) Tide Gates are available in 37 sizes from 8″ × 8″ to 96″ × 96″. Bulletin No. 71 describes them fully.

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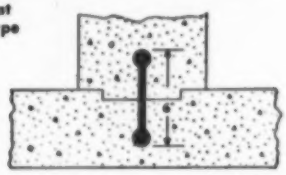
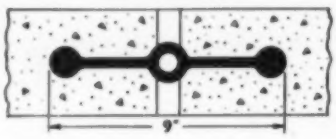
Flat Type



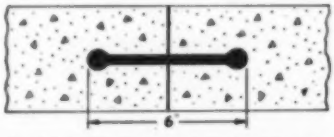
FOR EXPANSION JOINTS

Center Bulb Type



FOR CONSTRUCTION JOINTS

Flat Type



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Literature Available

DRY BRICK WALLS—A booklet describes and illustrates the type of workmanship which, together with proper design, will insure watertight walls. **Louisville Cement Co., Inc., Speed Building, Louisville, Kentucky.**

SPECIFICATION BOOKLETS—Three specifications booklets giving detailed information on the ¾ yd Model 75 A and Model 75 B excavators and the 75 BT truck cranes have been announced. The specification booklets show all the capacities, ranges, reaches and attachments available for all three models, considered the most convertible units made today. **Customer Service Dept., Gar Wood Industries Inc., Wayne, Mich.**

PRESERVATIVE AND DECORATIVE COATINGS—Catalog No. 50 on Tnemec preservative and decorative coatings is available. The 54-page book has numerous photographs, lists products and important data. Specifications based on service records beginning in 1921 and covering a wide variety of problems, are shown in back of catalog. **Tnemec Company, Inc., 125 West 23rd Ave., North Kansas City 16, Mo.**

ROTARY DISTRIBUTORS—A Technical Supplement "RD" covering American rotary distributors has been published. It gives comprehensive design data and information on reaction driven and positive motor driven rotary distributors and dosing siphons, for rapid or standard rate sewage filters, sand filters, or for water aeration. Design, construction, operating and performance features are fully explained. Important details are visualized in photographs, cross-sectional drawings and operating diagrams. **The American Well Works, Aurora, Ill.**

SHOVELOADER—Two-color literature describing the construction and industrial uses of the Baker-Lull Shoveloader has been issued. The literature illustrates applications and attachments for the front end loader, lists specifications of the equipment and describes performance characteristics. **Department KP, Baker-Lull Manufacturing Co., 314 W. 90th St., Minneapolis 20, Minn.**

PIPELINE PROTECTION MATERIAL—A 6-page folder on Trantex Tape, a cold-applied pipeline wrap developed by Johns-Manville for corrosion protection for underground gas and oil pipelines and overhead piping, has recently been published. This folder stresses the important advantages of Trantex Tape as a pipeline protection material. It illustrates and explains where and how this coating material can provide economies in specific field applications. In addition, reference tables on Trantex Tape properties, coverage data and packaging are included in the folder. **Johns-Manville, 22 East 40th St., New York 16, N. Y.**

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Literature Available (Continued)

TRAILERS—Files on the Tilt-To-Load trailers, Low Bed heavy duty trailers (Model M and Model MTS) are available. Specifications are included. **Dorsey Trailers, Elba, Ala.**

HOISTS—A 25-page general catalog on hoists is available. Roller bearing hoists for scraper storage machines, scraper excavating machines, tautline cableway machines, slackline cableway machines and brake and clutch controls for Sauerman hoists, are shown. Important features, photographs, etc., are included. **Sauerman Bros., Inc., 522 S. Clinton St., Chicago 7, Ill.**

CONCRETE PRESSURE PIPE—A booklet containing instructions for laying Price concrete pressure pipe is available. This pipe can be easily, rapidly and for that reason economically laid because of the simple flexible joint in which close tolerances are maintained and in which steel eventually takes the backload and a rubber gasket forms the seal. Experience has shown that the most practical way to lay Price pipe is with a backhoe, although other methods are often used. This booklet primarily describes the backhoe method. Photographs, diagrams, etc., are included. **Price Brothers Company, Dayton 1, Ohio**

TRUCK CRANE—A 6-page illustrated bulletin describing the 6-ton, ⅜ yd Model T-35 truck crane has just been issued. The bulletin contains detailed mechanical specifications, together with complete dimensions and operating data, including information on various truck mountings and typical interchangeable attachments used with the Bantam crane boom. Ask for Bulletin No. TCR-201. **Schield Bantam Company, Waverly, Iowa**

HYDRAULIC END-LOADERS—A technical bulletin descriptive of Galion Load-evators, hydraulic end-loaders, is announced. An outstanding catalog feature is a brief specification chart which permits the user to select the exact Load-evator model best suited to his needs. Action photographs, mounting diagrams, complete technical data information and operating hints are also included. Ask for L-6911. **The Galion Allsteel Body Company, Galion, Ohio**

DIESEL ELECTRIC SETS—A detailed description of five Caterpillar Diesel electric sets is contained in a booklet published recently. The booklet, with 50 illustrations, points up the ability, reliability, adaptability, durability, portability and economy of these five models—D17000, D13000, D8800, D318, D315 and D311. One of the features of this publication is two cutaway views of a D13000 Diesel electric set on the two center pages which show the distinctive features built into these Caterpillar products. **Caterpillar Tractor Co., Peoria, Ill.**

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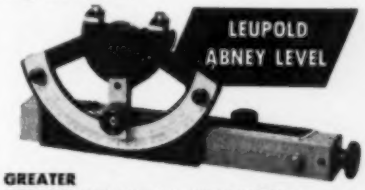

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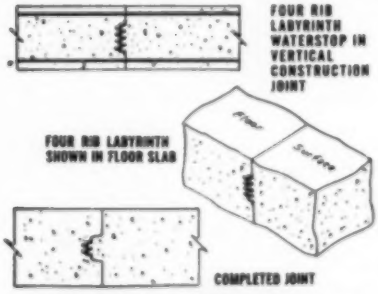

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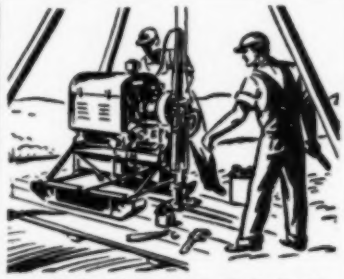
Films Available

EARTHMOVING UNITS—A 16mm sound film in color showing the Heiliner-Scraper and Bottom Dump Wagon in action has been released. Both the 18 cu yd model 2C800 and the 15 cu yd model 2C500 Heiliners are featured. Job shots of Heiliner-Scrapers and Bottom Dump Wagons in actual operation show the hi-speed earthmoving units working in different types of material. Scenes made on the Heil test grounds demonstrate the ruggedness and easy handling of the Heiliner. Complete operating details fully illustrate the fast loading and positive ejection features found in Heiliner scrapers. This 400 ft, 12 min movie is available to contractors, mine operators, and interested industrial firms from district Heil sales offices and their Heiliner distributor. Educational institutions may request the film through **The Heil Co., Road Machinery Division, Milwaukee 1, Wis.**

REBUILDING ROADS—Available for showing is a 16mm sound color movie featuring the Hyster Grid Roller in action on different types of blacktop jobs, including salvaging and rebuilding of roads and streets. The movie graphically illustrates the Grid Roller method for salvaging aggregate and binder in old bituminous surfaces; and a new faster way to compact road fills, sub bases and rolling surface courses. Used on all types of jobs throughout the country, the Grid Roller principle will be of interest to road builders and officials of state, county and other governmental agencies everywhere who are interested in a new method of doing a better job at less cost. Arrangements to book the Grid Roller movie can be made at any Caterpillar-Hyster dealer; or for information, write: **Hyster Company, 2902 N. E. Clackamas St., Portland 8, Ore.**

MOTOR GRADER—A 16mm color and sound movie entitled "Galion Makes the Grade" has been completed. This twenty-three min film will be shown by Galion distributors. The film is said to show in dramatic action the wonderful versatility of a Galion Motor Grader. All scenes were taken during the progress of actual construction and maintenance work, and therefore give a good idea of the on-the-job performance of a Galion Grader. Also included are animation sequences of the operation of the Galion hydraulic system, hydraulic side shift, gear type tandem drive, and range of operating speeds. All types of operations, such as flat bottom ditching, bank sloping, grading, mix-in-place, etc., are presented in detail. In addition, many interesting factory scenes are included showing important steps in the manufacture of Galion graders. Contact your Galion distributor who will be pleased to arrange a showing. Those who would like to show the film, such as engineering schools, clubs, and other organizations interested in better roads, are requested to write direct to **The Galion Iron Works & Mfg. Company, Galion, Ohio**



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169. **Rating Curves for Flow over Drum Gates,** by Joseph N. Bradley.

170. **Rapid Computation of Flexural Constants,** by Thomas G. Morrison.

171. **Unified Mass-Transportation System for New York,** by William Reid.

172. **Aeronautical Charting and Mapping,** by Charles A. Schanck.

173. **Electronic Devices in Air Transport,** by F. B. Lee.

174. **Zoning Maps for Airports,** by Benjamin Everett **Beavin,** Sr.

175. **Design of Side Walls in Chutes and Spillways,** by D. B. Gumensky.

D-121. Discussion of Paper, **Rate of Change of Grade per Station,** by Clarence J. Brownell.

D-127. Discussion of Paper, **Stresses in Deep Beams,** by Li Chow, Harry D. Conway, and George Winter.

176. **Advances in Sewage Treatment and Present Status of the Art: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment.**

177. **Earthquake Stresses in Shear Buildings,** by M. G. Salvadori.

178. **Rainfall Studies Using Rain-Gage Networks and Radar,** by H. E. Hudson, Jr., G. E. Stout, and F. A. Huff.

179. **Stiffness Charts for Gusseted Members Under Axial Load,** by John E. Goldberg.

180. **A Direct Step Method for Computing Water-Surface Profiles,** by Arthur A. Ezra.

D-123. Discussion of Paper, **Long-Period Waves or Surges in Harbors,** by John H. Carr.

D-126. Discussion of Paper, **Variation of Wind Velocity and Gusts with Height,** by R. H. Sherlock.

D-128. Discussion of Paper, **Horizontally Curved Box Beams,** by Charles E. Cutts.

181. **Slackwater Improvement of the Columbia River,** by O. E. Walsh.

182. **Hipped Plate Analysis, Considering Joint Displacement,** by Ibrahim Gaafar.

183. **Group Loadings Applied to the Analysis of Frames,** by I. F. Morrison.

184. **Dam Modifications Checked by Hydraulic Models,** by E. S. Harrison and Carl E. Kindsvater.

185. **Nonelastic Behavior of Bridges Under Impulsive Loads,** by S. J. Fraenkel and L. E. Grinter.

186. **Settling Rates of Suspensions in Solids Contact Units,** by A. A. Kalinske.

187. **The Equivalent Rectangle in Prestressed Concrete Design,** by John J. Peebles.

188. **Laminar to Turbulent Flow in a Wide Open Channel,** by W. M. Owen.

D-135. Discussion of Paper, **Application of Electronic Flow Routing Analog,** by Max A. Kohler. The electronic stream-flow analog of the Weather Bureau was studied in the original paper, published in June, 1952. This analog was found effective for river forecasts where the Muskingum storage equation is applicable. The basis for the circuit used in the analog and the methods of operating the equipment were discussed briefly in the paper, together with an explanation of a basis for making analog routing more universally applicable. Discussers are: Alfred J. Cooper, and C. O. Clark.

D-136. Discussion of Paper, **Steady-State Forced Vibration of Continuous Frames,** by C. T. G. Looney. The original paper, published in June, 1952, described a method of analysis for the steady-state forced vibration of continuous frames. All members are considered as simply supported, and the geometrical discontinuity with adjacent members is corrected by means of a distribution procedure. Discussers are: E. F. Masur, A. S. Veletsos, and William A. Conwell.

189. **Snow Hydrology for Multiple-Purpose Reservoirs,** by H. S. Riesbol. This paper presents criteria and examples of procedures followed, in their application to the determination of reservoir space allocations and spillway capacities. It brings to the attention of the profession those characteristics of snow that can be evaluated and applied to advantage, both from a hydrologic and an economic viewpoint, in the planning and design of multiple-purpose storage reservoirs. The writer explains that a gap exists between detailed physical knowledge of the processes of snow evaporation and melting and the application of this knowledge to practical design problems.

190. **Analysis of Corrective Actions for Highway Landslides,** by R. F. Baker. A semi-rational approach to the correction of highway earth-movement failures is presented in this paper. The analysis of these failures is based upon a classification system involving the mechanics of movement. A more general use of basic mechanics is used to estimate the effect of corrective measures and the control method selected is chosen not only for its effectiveness, but also for its economic feasibility. The analysis presented is semi-rational, and for general application extensive development and observations are still necessary. It is concluded that there is a need for a rational and scientific approach to the analysis of highway landslides.

191. **The Engineer's Role in Metropolitan Traffic Planning,** by Lloyd Braff Successful

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community growth depends considerably on effective long-range traffic planning. The engineer must not only organize and apply traffic studies and design the required highway systems, he must also be active in coordinating the work of the various branches of city government affected by the work. This paper describes the problems involved and cites the work in Dallas, Tex., as an example of the proper approach to solving such problems.

192. **Relief Well Systems for Dams and Levees,** by W. J. Turnbull and C. I. Mansur. Excessive seepage and sand boils occur frequently during high water where dams or levees are underlain by strata of pervious sands and gravels. This paper presents the results of an investigation in which sand models were used to study the following: (1) The phenomena of underseepage; (2) the use of pressure relief wells as a means of controlling underseepage and sand boils along the lower Mississippi River levees; (3) the operation of relief wells; (4) the well and seepage flows; and (5) the landward substratum pressures with and without relief wells in operation, for various foundations, seepage entrances, and top strata. The conditions studied were those considered to represent qualitatively conditions commonly encountered in the lower Mississippi River valley.

193. **Velocity Measurement of Air-Water Mixtures,** by L. G. Straub, J. M. Killen, and O. P. Lamb. The insufflation of air into high flow-velocity streams of water is one of the many fluid mechanics phenomena still retarded in its complete analytical explanation by the inadequacy of instrumentation required for experimental observation. This paper traces the development and use of a velocity measuring instrument at the St. Anthony Falls Hydraulic Laboratory. The meter is used in conjunction with a cathode-ray tube and is most satisfactory for laboratory investigations. Studies indicate that the instrument might be used for turbulence measurements and velocity measurements of fluid mixtures other than water, and that a portable model may be adaptable to field conditions.

D-129. Discussion of paper, **Analysis of Arch Dams of Variable Thickness,** by W. A. Perkins. The original paper, published in May 1952, related the difficulties in determining the stresses for an arch thicker at the abutment than at the crown. Formulas and curves were presented to simplify the process of determining these stresses. Discussers are: Alfred L. Parme, L. J. Mensch, Fairfax D. Kirn and Gurmukh S. Sarkaria, A. C. Josephs, G. E. Goodall, and W. A. Perkins.

D-138. Discussion of paper, **The Value and Administration of a Zoning Plan,** by Huber Earl Smutz. In the original paper, which was published in July 1952, twentieth century progress in city planning and zoning was discussed with particular reference to zoning. Discussers are: Henry Horowitz, and Huber Earl Smutz.

D-145. Discussion of paper, **Torsion of I-Type and H-Type Beams,** by John E. Goldberg. In the original paper, published in August 1952, a review of torsion of I-Type and H-Type sections, the basic differential equation for the twisting of such sections, and particular solutions of the differential equation were presented with reference to various problems, including that of a framed floor panel. Discussers are: Kurt H. Gerstle, and John E. Goldberg.

194. **City Planning Techniques,** by Russell H. Riley. An explanation of some of the procedures followed in preparing a good city plan is presented in this paper. Of particular interest to engineers is the clarification of the part played by the engineer in city planning, together with that of the layman and the city official. Various procedures that have been used are analyzed, and the most desirable method is described at some length.

195. **Special Procedures for Pavement Design,** by L. A. Palmer. The pavement extension and reinforcement program of the Bureau of Yards and Docks, United States Department of the Navy, is described in this paper. The unusual requirements imposed by modern aircraft have given rise to the establishment of new criteria and procedures. This paper offers the opportunity to study and discuss the results of the research and experience in pavement design and construction following an extensive program of airfield improvement.

196. **Recent Airport Design and Development,** by Philip A. Hahn. Recent developments and trends in airport design and construction are of rather common knowledge to the engineer. This paper presents the reasons for these trends and developments. These advances have been based on engineering principles which are basically sound and economically wise. There is still another important factor which controls airport engineering—and that is the need for providing the necessary aeronautical requirements to insure the safe operation of aircraft in the vicinity of the airport, in turning zones or areas, in the approaches, and on the airport.

197. **Friction Factors for Turbulent Flow in Pipes,** by Edward F. Wilsey. Two formulas are developed for the evaluation of friction factors for turbulent flow in pipes. These formulas differ from the equations proposed by former experimenters in this field in that the author makes use of the hyperbolic cotangent of a function of the Reynolds number. The resulting expression is relatively simple when compared with equations that are in common usage in the field of hydraulics. All that is required to solve them is a set of mathematical tables.

198. **Live Loading for Long-Span Highway Bridges,** by R. J. Ivy, T. Y. Lin, Stewart Mitchell, N. C. Raab, V. J. Richey, and C. F. Scheffey. The selection of a suitable live loading for long spans has been left to the discretion of the designing engineer—in contrast to the standardization, in various codes, for short and medium spans. The authors present for study and discussion a loading to be used as a design standard, and a system of accompanying allowable unit stresses intended to provide for the economic design of long spans. The recommendations are based on studies involving actual highway vehicle weights and groupings.

199. **Plates with Boundary Conditions of Elastic Support,** by S. J. Fuchs, M. ASCE. By use of a double Fourier series, the author obtains a solution for the reactions, deflections, and moments in a rectangular plate under transverse load. A specific problem is solved by use of the author's method of procedure—suitable curves are plotted, and experimental verification is offered. The paper is a concise presentation of an interesting method of approach to the solution of plate problems. The method of solution may be applied not only to transversely loaded plates but also to physical problems that involve harmonic or biharmonic differential equations.

D-134. Discussion of Paper, **Solution of an Hydraulic Problem by Analog Computer,** by R. E. Glover, D. J. Hebert, and C. R. Daum. The original paper, published in June 1952, described the general conditions of the problem of flow distribution in a network of estuarine channels to which an analog computer model was applied. Discussers are: J. van Veen; W. Douglas Baines; T. Blench; and R. E. Glover, D. J. Hebert, and C. R. Daum.

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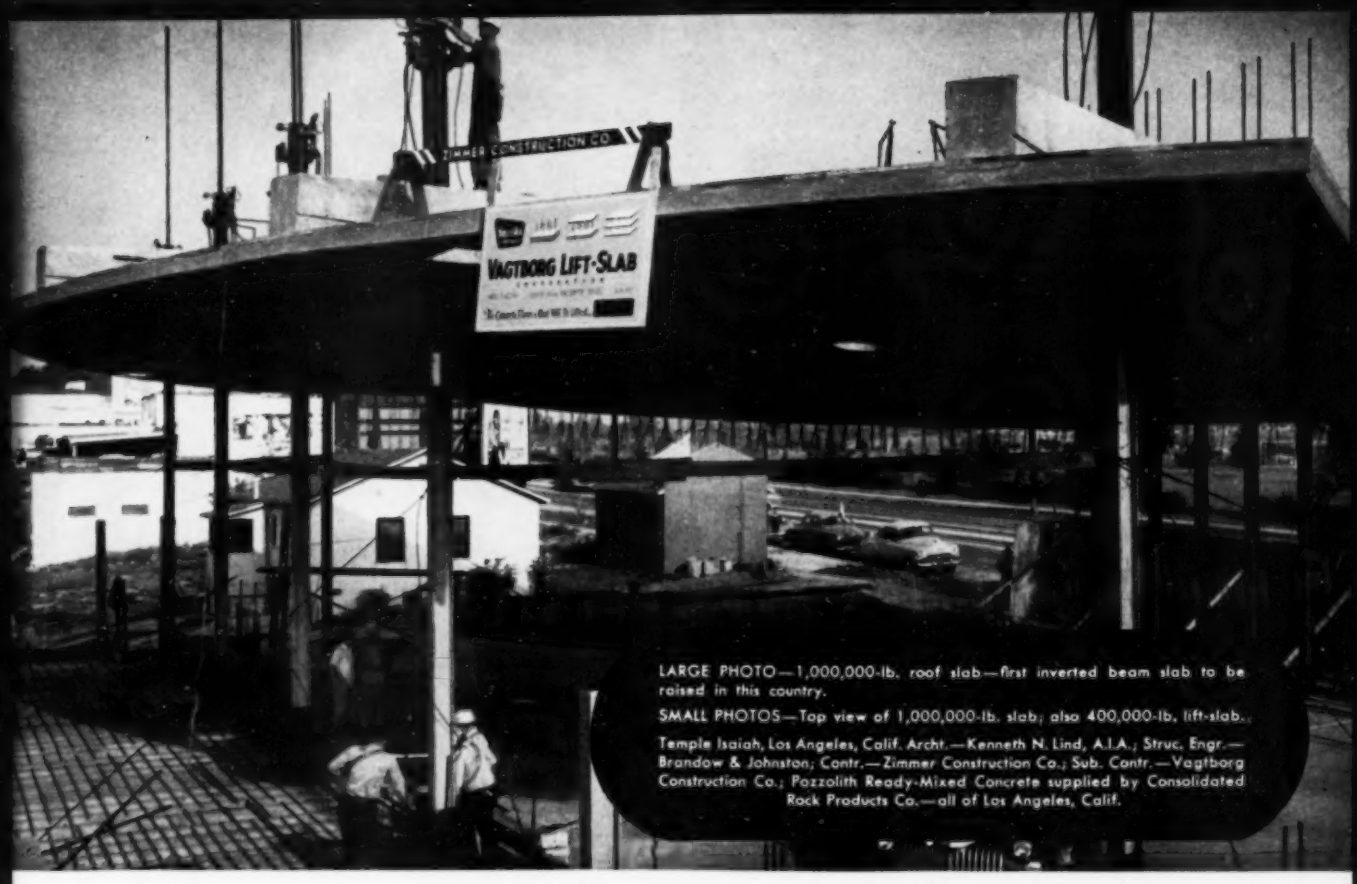

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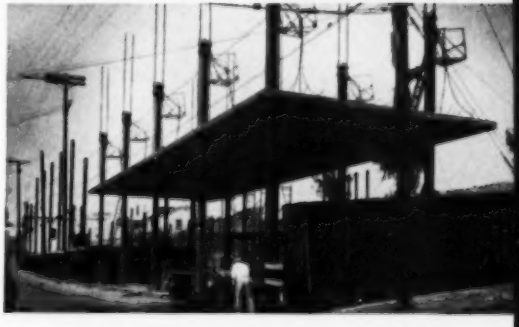

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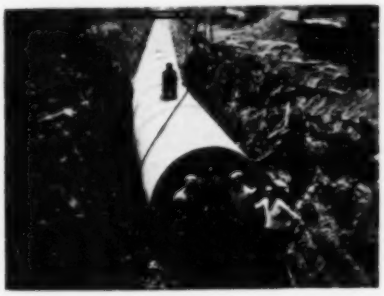

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